

## **DIVISION 700 MISCELLANEOUS CONSTRUCTION**

- 701 Curb and Integral Curb and Gutter
- 705 Portland Cement Concrete Sidewalk
- 707 Corrugated Steel Downspouts 268
- 708 Drainage Inlets and Manholes
- 710 Adjusting and Repairing Drainage Inlets and Manholes
- 712 Riprap
- 714 Ditching
- 715 Perforated Pipe Underdrains
- 716 Converting Drainage Inlets to Junction Boxes
- 717 Permanent Roadway Drains
- 718 Roof Drains
- 720 Galvanized Steel Beam Guardrail
- 725 Guardrail-to-Barrier Connection (Approach and Exit Types)
- 726 Guardrail End Treatment
- 727 Fences and Gates
- 732 Topsoil
- 733 Topsoiling
- 734 Seeding
- 735 Mulching
- 736 Sodding
- 737 Planting
- 738 Transplanting
- 741 Tree Removal
- 743 Arrow Boards
- 744 Conduit Junction Wells
- 745 Conduits (Non-Metallic or Galvanized)
- 746 Pole Bases
- 747 Cabinet Bases
- 748 Pavement Markings
- 749 Reinforced Concrete Sign Foundations
- 750 Adjusting Water Valve Boxes
- 751 Adjusting Fire Hydrants
- 752 Relocating Fire Hydrants
- 753 Adjusting Sanitary Sewer Laterals
- 754 Adjusting Water Services

755	Hot-Mix, Hot-Laid Bituminous Concrete Curb
756	Sand
758	Removal of Existing Portland Cement Concrete Pavement, Curb, and Sidewalk
759	Field Office
760	Pavement - Milling
761	Butt Joints
762	Saw Cutting Portland Cement and Hot-Mix, Hot-Laid Bituminous Concrete
763	Initial Expense

## **DIVISION 700 MISCELLANEOUS CONSTRUCTION**

### **PORTLAND CEMENT CONCRETE**

#### **SECTION 701 CURB AND INTEGRAL CURB AND GUTTER**

**701.01 Description.** This work consists of constructing curbs and integral curbs and gutters on a prepared foundation using either fixed forms or slip forms.

#### **MATERIALS.**

**701.02 Portland Cement Concrete.** Portland cement concrete shall conform to the requirements of Section 812, Class B for either fixed-form work or slip-form work.

**701.03 Preformed Expansion Joint Material.** Preformed expansion joint material shall be 2" (13 mm) nominal thickness and conform to the requirements of Subsection 808.06.

**701.04 Bituminous Joint Sealant.** Bituminous joint sealant shall conform to the requirements of Subsection 808.04 (c).

#### **CONSTRUCTION METHODS.**

**701.05 Preparation of Foundation.** The foundation shall be prepared at the required grade to accommodate the elevations, dimensions, and details shown on the Plans. Existing undisturbed soil, where used as foundation, shall be firm and unyielding. All unsuitable material shall be removed and replaced with approved material. When the foundation is to be any material other than existing undisturbed soil, the compaction and density requirements for the Section covering the material shall govern. Where rock is encountered, the grade shall be excavated to 6" (150 mm) below the bottom of the curb and integral curb and gutter and backfilled with approved material.

**701.06 Forms.** Fixed forms shall be of wood or metal and shall extend the full depth of the concrete. Composite material forms may be used for radii work. Forms shall be straight, free from warp, and of sufficient strength to resist the pressure of the concrete, and shall not displace more than 3/8" in 10' (10 mm in 3 m) from the vertical or horizontal plane. Forms shall remain in both horizontal and vertical alignment until their removal. Forms shall be clean and coated with an approved form release agent before concrete is placed. Divider plates shall be metal.

**701.07 Slip-Forming.** When slip-forming is permitted, contraction joints shall be constructed at 20' (6 m) intervals. All surfaces front, top, and back shall be tooled or sawed to a minimum depth of 1" (25 mm) and a minimum width of 1/8" (3 mm). Where slip-forming is used, expansion joints shall be constructed at radius points, structures, obstructions, and 200' (60 m) intervals.

**701.08 Concrete.** The concrete shall be placed on a moist foundation between the forms, consolidated, and worked sufficiently to bring mortar to the surface. The surface shall be struck off to the required contour and finished smooth and even with an approved float.

Limitations on placing concrete during hot or cold weather shall be as specified in Subsection 501.04.

**701.09 Construction of Sections.** All transverse joints shall be sealed with approved joint sealant. The sealing shall be performed immediately after the concrete has cured for 72 hours. Longitudinal joints shall be tooled adjacent to rigid pavements and structures and sealed with approved joint filler. This work shall be constructed in sections having a uniform length of approximately 10' (3 m). Sections shall be separated by open joints at least 1/8" (3 mm) wide by use of steel templates. Templates shall be not less than 2" (50 mm) longer than the depth of the curb. Templates shall be secured during the placing of concrete and shall remain in place until concrete has set sufficiently. No sections shall be less than 5' (1.5 m) in length.

**701.10 Expansion Joints for Fixed Forms.** Expansion joints shall be formed in curb and in integral curb and gutter at 40' (12 m) intervals. When constructed adjacent to concrete pavement, expansion joints shall coincide with the expansion joints in the pavement.

**701.11 Finishing.** A wood or magnesium float shall be used to rub the surface smooth while the concrete is still green. A steel trowel finish shall next be applied, and finally a soft dampened brush shall be used longitudinally along the surface. Finishing shall be performed to a depth of 2" (50 mm) below the proposed pavement surface elevation.

Before the concrete is given the final finish, the flow line of the gutter shall be checked and any irregularities of more than 1/8" in 10' (3 mm in 3 m) shall be corrected.

Irregularities in grade or alignment of the exposed surfaces shall not exceed 3/8" in 10' (10 mm in 3 m). Vertical alignment shall be sufficiently uniform and regular to ensure complete drainage.

**701.12 Removal of Forms.** Front forms may be removed as soon as concrete has hardened sufficiently. Rear and side forms shall not be removed for at least 12 hours. Surfaces exposed after 12 hours but prior to 72 hours shall be cured using materials specified in Section 812 or immediately backfilled. Minor defects shall be filled with mortar conforming to the requirements of Section 611.

**701.13 Curing.** Immediately, upon the completion of finishing, all exposed surfaces shall be cured for 72 hours using curing materials specified in Section 812. During the curing period, pedestrian and vehicular traffic shall not disturb newly completed curb or integral curb and gutter.

**701.14 Backfilling.** As soon as possible after the removal of forms or completion of the slip-form operation, the spaces adjacent to the curb and integral curb and gutter shall be backfilled to the required elevation with suitable material until firm and solid.

**701.15 Method of Measurement.** The quantity of Portland cement concrete curb and integral curb and gutter will be measured as the number of linear feet (linear meters) along the front face of the finished curb.

**701.16 Basis of Payment.** The quantity of Portland cement concrete curb and integral curb and gutter will be paid for at the Contract price per linear foot (linear meter). Price and payment will constitute full compensation for excavating [limited to 1' (300 mm) in depth], furnishing, and placing all materials; for forming, placing, finishing, and curing concrete; for backfilling, compacting, and disposing of surplus materials; for sealing joints; and for all labor equipment, tools, and incidentals required to complete the work. If other than existing soil is approved for use as foundation material, it will be measured and paid for under the appropriate Section. If rock is encountered, measurement and payment for removal of the rock will be made under Section 206.

## **SECTIONS 702 through 704 S RESERVED**

## **SECTION 705 PORTLAND CEMENT CONCRETE SIDEWALK**

**705.01 Description.** This work consists of constructing Portland cement concrete sidewalk on a prepared foundation.

## **MATERIALS.**

**705.02 Portland Cement Concrete.** Portland cement concrete shall conform to the requirements of Section 812, Class B.

**705.03 Preformed Expansion Joint Material.** Expansion joint material shall conform to the requirements of Subsection 808.06.

**705.04 Curing Material.** Curing materials shall conform to the requirements of Subsection 812.02 (i).

## **CONSTRUCTION METHODS.**

**705.05 Preparation of Foundation.** The foundation shall be formed at the required grade to accommodate the elevations, dimensions, and details shown on the Plans for the bottom of the sidewalk. Where the sidewalk foundation is to be existing undisturbed soil, the foundation shall be firm and unyielding. All soft and yielding or other unsuitable material shall be removed and replaced with approved granular material. When the sidewalk foundation is to be any material other than existing undisturbed soil, the compaction and density requirements for the Section covering that material shall govern. Where rock is encountered, the grade shall be excavated to 6" (150 mm) below the bottom of the sidewalk, backfilled with approved granular material, and thoroughly compacted.

**705.06 Forms.** Forms shall be of wood or metal and shall extend the full depth of the concrete. Composite material forms may be used for radii work. Forms shall be straight, free from warp, and of sufficient strength to resist the pressure of the concrete, and shall not displace more than 3/8" in 10' (10 mm in 3 m) from the vertical or horizontal plane. Forms shall remain in both horizontal and vertical alignment until their removal. Forms shall be clean and coated with an approved form release agent before concrete is placed.

**705.07 Placing and Finishing Concrete.** The concrete shall be distributed to the required depth and for the entire width of the slab by shoveling, or an approved method which preserves the integrity of the mixture. Concrete shall be thoroughly spaded along all joints and on the inside of the forms for its entire depth. The concrete shall be leveled and immediately struck-off by means of an approved screed. The screed shall be shaped to the required crown and of sufficient strength to retain its shape under all working conditions.

While the concrete is still moist, it shall be floated with an approved float of either wood or metal to ensure that all irregularities or depressions are filled. The final finish shall be obtained by either a wood float or hair broom. Concrete shall be finished in accordance with Subsection 501.11. If concrete is permitted to be placed during cold weather, it shall be placed in accordance with Section 501.

The sidewalk shall be marked into rectangular slabs 5' (1.5 m) long by scoring, 2" (13 mm) minimum, with approved edging tools. The surface edges of each slab shall be rounded to a 3" (6 mm) radius.

**705.08 Expansion Joints.** Expansion joints shall extend from the surface to the foundation and must be at right angles to the sidewalk surface. A 2" (13 mm) expansion joint, shall be placed across the walk every 20' (6 m). This distance may be adjusted slightly to match existing joints in previously placed concrete work. Expansion material shall also be placed longitudinally along one side when sidewalk is placed between curbs, pavements, or any fixed structures. Joints shall be formed around all appurtenances, such as manholes, utility boxes, and poles that extend into and through the sidewalk.

**705.09 Curing.** Concrete shall be cured according to Section 501 for a period of five days. The sidewalk shall not be opened to pedestrian and vehicular traffic until the end of the curing period.

**705.10 Backfill.** Immediately at the end of the curing period, the sidewalk shall be backfilled with approved material.

**705.11 Method of Measurement.** The quantity of Portland cement concrete sidewalk will be measured as the number of square feet (square meters) measured at the surface of the sidewalk, placed and accepted.

**705.12 Basis of Payment.** The quantity of Portland cement concrete sidewalk will be paid for at the Contract unit price per square foot (square meter). Price and payment will constitute full compensation for furnishing, hauling, and placing all materials; for preparing the foundation; for shaping the shoulders; for replacing rejected sidewalk; and for all labor,

equipment, tools, and incidentals required to complete the work. If other than existing soil is approved for use as foundation material, it will be measured and paid for under the appropriate Section. If rock is encountered, measurement and payment for removal of the rock will be made under Section 206.

## **SECTION 706 S RESERVED**

### **DRAINAGE**

## **SECTION 707 CORRUGATED STEEL DOWNSPOUTS**

**707.01 Description.** This work consists of placing corrugated steel pipe downspouts in fill slopes from Portland cement concrete intake aprons and intake basins to discharge points at the top of slopes or to downspout splash aprons.

### **MATERIALS.**

**707.02 Pipe.** Corrugated steel pipe shall conform to AASHTO M 36/M 36M.

**707.03 Concrete.** Materials and composition of the mix shall conform to the requirements of Section 812, Class B.

### **CONSTRUCTION METHODS.**

**707.04 Downspout Splash Aprons.** Reinforced Portland cement concrete splash aprons shall be placed at the discharge end of the corrugated steel downspouts at elevations shown on the Plans. Splash aprons shall be constructed according to the requirements of Section 602.

**707.05 Intake Aprons.** Portland cement concrete intake aprons shall be placed in the roadway shoulder at the locations and to the elevations shown on the Plans. The shapes and elevations shall be set and maintained with forms. The contours of the surface shall be shaped by hand methods using templates as necessary. Intake aprons shall be constructed according to the requirements of Section 602.

**707.06 Intake Basins.** Reinforced Portland cement concrete intake basins shall be placed in the roadway shoulder at the locations and to the elevations shown on the Plans. The intake basins shall be constructed according to the requirements of Section 708.

**707.07 Final Site Work and Cleanup.** The discharge end of the pipe shall be completed as shown on the Plans. When all construction on the intake, downspout, and splash aprons has been completed, all excess earthwork and debris shall be removed. The areas shall conform to the typical section, and the site of each operation shall be left in a neat condition.

**707.08 Method of Measurement.** The quantity of corrugated steel downspout will be measured as the number of linear feet (linear meters) of downspout placed, including bends, measured along the downspout from the intake end to the discharge end of the pipe. The quantity of intake basins, intake aprons, and downspout splash aprons will be measured as the number of each constructed basin and apron placed.

### **707.09 Basis of Payment.**

- a. *Corrugated Steel Downspouts.* The quantity of corrugated steel downspouts will be paid for at the Contract unit price per linear foot (linear meter).
- b. *Intake Aprons.* The quantity of intake aprons will be paid for at the Contract unit price for each intake apron.
- c. *Intake Basins.* The quantity of intake basins will be paid for at the Contract unit price for each intake basin.
- d. *Downspout Splash Aprons.* The quantity of downspout splash aprons will be paid for at the Contract unit price for each downspout splash apron.

Price and payment for all items in this Section will constitute full compensation for furnishing and placing all materials, including bar reinforcement, course aggregate, and grating; for excavating, backfilling, regrading shoulders and slopes,

site clearing, and disposing of surplus material; and for all labor, equipment, tools, and incidentals required to complete the work.

## **SECTION 708 DRAINAGE INLETS AND MANHOLES**

**708.01 Description.** This work consists of the construction of reinforced Portland cement concrete drainage inlets and manholes.

### **MATERIALS.**

**708.02 Portland Cement Concrete.** Portland cement concrete shall conform to the requirements of Section 812, Class B.

**708.03 Mortar.** Mortar shall conform to the requirements of Section 611.

**708.04 Bar Reinforcement.** Bar reinforcement shall conform to the requirements of Section 824.

**708.05 Castings.** Castings for frames and covers shall conform to AASHTO M 105, Class 30. Castings shall be boldly filleted at angles, and the arises shall be sharp and exact. Castings shall be true to pattern in form and dimension and free from pouring faults, sponginess, cracks, blowholes, and other defects that impair the strength and value for the service intended.

**708.06 Gratings.** Gratings shall be fabricated as shown on the Plans and the Standard Construction Details from cast iron conforming to the requirements of ASTM A 48, Class 30.

**708.07 Steps.** Drainage inlet steps shall be of the type constructed of molded plastic with a reinforcing bar core, conforming to the requirements of AASHTO M 31/M 31M, and ASTM A 478, and D 4101.

### **CONSTRUCTION METHODS.**

**708.08 Excavation.** Excavation shall be made to the required depth. The foundation upon which the concrete floor of the drainage inlet is to be placed shall be compacted to a firm, even surface.

**708.09 Reinforced Concrete Construction.** Reinforced concrete drainage inlets and manholes shall be constructed according to the requirements of Section 602.

**708.10 Precast Drainage Inlets and Manholes.** Precast drainage inlets and manholes shall be constructed as shown on the Standard Construction Details.

The annular space of joints between precast sections shall be filled with a joint sealant meeting the requirements of AASHTO M 198.

**708.11 Frames of Castings.** Frames of castings shall be set in full mortar beds.

**708.12 Steps.** All drainage inlets and manholes which are 4' (1.2 m) or more in depth, measured from the top of grate or cover to the invert of the lowest pipe, shall have steps installed on the back wall or as specified on the Plans. The steps shall be embedded a minimum of 3" (75 mm) in the wall, protrude out 6" (150 mm) from the wall, start within 24" (600 mm) of the top of grate/lid, end no more than 12" (300 mm) above the lowest invert (except where a pipe is in the backwall), and be spaced vertically at 12" (300 mm) intervals.

**708.13 Inlet and Outlet Pipes.** Inlet and outlet pipes shall be the same size and type as the connecting pipes shown on the Plans and shall extend through the walls and be flush with the inside of the wall.

If an end of reinforced concrete pipe is cut off, the end shall be cut clean and smoothly finished with mortar so that no bar reinforcement remains exposed. Any space between the pipe and the walls of the precast drainage inlet shall be filled with non-shrink grout conforming to the requirements of ASTM C 1107. The greatest dimension of the opening in the drainage inlet for the pipe shall be no greater than the outside pipe diameter plus 4" (100 mm).

**708.14 Backfill.** The area around drainage inlets and manholes shall be backfilled with Borrow Type C material to the required elevation. Backfill placement shall be in 6" (150 mm), loose-thickness lifts. Each lift shall be placed and compacted to 95% or more of the maximum density. No backfill shall be placed prior to approval.

**708.15 Method of Measurement.** The quantity of drainage inlets and manholes will be measured as the actual number of each, installed and accepted. Inlet and outlet pipe will not be measured under this Section, but will be measured with the adjoining pipe under the appropriate Section for the size and type of pipe installed.

**708.16 Basis of Payment.** The quantity of drainage inlets and manholes will be paid for at the Contract unit price for each drainage inlet or manhole. Price and payment will constitute full compensation for furnishing and placing all materials, including any necessary fittings, metal frames, gratings, covers, top units, and hoods; for excavating, backfill, backfilling, compacting, and disposing of surplus materials; and for all labor, equipment, tools, and incidentals required to complete the work. If rock is encountered, rock excavation will be paid under Section 206. Inlet and outlet pipe will be paid for under the appropriate Section for the size and type of pipe installed.

## **SECTION 709 S RESERVED**

## **SECTION 710 ADJUSTING AND REPAIRING DRAINAGE INLETS AND MANHOLES**

**710.01 Description.** This work consists of adjusting and repairing existing drainage inlets and manholes.  
**MATERIALS.**

**710.02 Portland Cement Concrete.** Portland cement concrete shall conform to the requirements of Section 812, Class B.

**710.03 Mortar.** Mortar shall conform to the requirements of Section 611.

**710.04 Brick.** Brick shall conform to the requirements of Section 611 or shall be concrete brick conforming to the requirements of ASTM C 139, except absorption shall not exceed of 15 lb/ft<sup>3</sup>; (240 kg/m<sup>3</sup>).

**710.05 Select Borrow.** Select borrow, used as backfill, shall conform to the requirements of Subsection 209.04, Borrow Type C.

**710.06 Concrete Block.** Concrete block shall conform to the requirements of Section 819.  
**CONSTRUCTION METHODS.**

**710.07 Drainage Inlets and Manholes.** Drainage inlets and manholes, including the concrete curb portion of the drainage inlet, shall be adjusted to vertical grade. Drainage inlets and manholes shall be repaired as required, prior to the paving operations. The concrete curb portion of the drainage inlet shall be removed and replaced. Covers of drainage inlets and manholes shall be removed so that the Engineer can inspect the manhole or drainage inlet. Existing castings shall be removed and replaced on a full mortar bed, as required. At the direction of the Engineer, all reinforced concrete or masonry found to be in poor condition shall be rebuilt using materials conforming to the original structure's dimensions and construction type.

**710.08 Excavation and Backfill.** The materials necessary to be excavated to perform the work under this Section shall be removed from the site. All such excavations shall be backfilled with select borrow by methods conforming to the requirements of Section 708.

**710.09 Method of Measurement.** The quantity of drainage inlets and manholes adjusted or repaired will be measured as the actual number of each, adjusted or repaired.

**710.10 Basis of Payment.** The quantity of drainage inlets and manholes adjusted or repaired will be paid for at the Contract unit price for drainage inlets and manholes repaired from the top of grate (or cover) to a depth of 3' (900 mm) below. Drainage inlets and manholes repaired below a depth of 3' (900 mm), but not more than 42' (1.4 m), will be paid for at one and one-half times the unit price. Drainage inlets and manholes repaired below a depth of 42' (1.4 m) will be paid for at two times the unit price. Price and payment will constitute full compensation for excavating, backfilling, compacting, and disposing of materials; for removing and resetting covers and portions of structures; for furnishing and placing all materials, including the replacement of the concrete curb portion of drainage inlets and all mortar repair; and for all labor, equipment, tools and incidentals required to complete the work.

## **SECTION 711 S RESERVED**

## **SECTION 712 RIPRAP**

**712.01 Description.** This work consists of furnishing and placing dry, pre-mixed, bagged riprap and stone riprap. This work also consists of preparing the bedding areas for the placement of riprap.

## **MATERIALS.**

**712.02 Portland Cement Concrete.** The Portland cement, water for curing, and fine aggregate shall conform to the requirements of Section 812. The composition of the mix shall be a fine aggregate to cement ratio of 4:1 by weight. As an alternate, a dry mix of Class B concrete may be submitted. The fine aggregate to cement, or fine aggregate to cement to coarse aggregate, shall be mixed dry throughout, in the proportions specified. The mixed material shall be accurately measured into each bag, with care being taken to place the same amount of material in each bag. Immediately after filling, the bags shall be sealed ready for delivery to the Project site.

**712.03 Bags.** The bags shall be either multi-wall paper, perforated throughout on approximate 1" (25 mm) center, or a woven polyester or polypropylene mesh bag. The bags shall hold the mix without leakage when handled and shall permit the passage of water when wetted. The bags shall be of adequate seal, thickness, and strength to maintain the integrity of the riprap until the concrete mix has set. The dry bagged riprap shall be of uniform size, rectangular in shape, and approximately 4 or 6" (100 or 150 mm) thick, in order to provide a uniform appearance in the completed work. The bags shall be consistent in color and blend with the surrounding area. The bag composition shall be such that the bags will disintegrate without presenting environmental problems. Filled bags shall be free from tears and strong enough to handle without ripping or splitting. Only one type and size bag shall be used at any one structure. The filled bags shall weigh approximately 60 to 90 lb (27 to 41 kg) per bag with the following approximate size and capacity limits:

<b><u>US CUSTOMARY</u></b>			
<b>Bag Type</b>	<b>Nominal Filled Bag Size</b>	<b>Capacity</b>	<b>Bags/yd; (Dry)</b>
60 lb paper	4 by 12 by 18"	0.50 ft;	54
80 lb paper	4 by 14 by 21"	0.67 ft;	40
90 lb polypropylene	6 by 12 by 18"	0.75 ft;	36
<b><u>METRIC</u></b>			
<b>Bag Type</b>	<b>Nominal Filled Bag Size</b>	<b>Capacity</b>	<b>Bags/m<sup>3</sup>(Dry)</b>
27 kg paper	100 by 300 by 450 mm	0.014 m <sup>3</sup>	71
36 kg paper	100 by 350 by 525 mm	0.019 m <sup>3</sup>	52
41 kg polypropylene	150 by 300 by 450 mm	0.021 m <sup>3</sup>	47

The Contractor shall furnish to the Department, a Certificate of Compliance stating that both bag and blended material meet the above requirements. Prior to approval to proceed, the supplier's plant may be inspected by the Department. The Contractor shall also furnish sample bags of the type proposed for use in the work and shall not proceed with the work until the bags proposed for use have been approved. At least two weeks prior to delivery, samples of approximately 5 lb (2.3 kg) each of the fine aggregate and cement to be used in the dry mix shall be submitted to the Department.

**712.04 Stone.** Stone for riprap shall be hard, durable stone free from structural defects and foreign substances such as soil, shale, and organic materials. The stone shall be hard angular rock with neither width nor thickness less than one-third its length; the minimum specific gravity shall be 2.5, bulk-saturated, surface-dry basis; and each load shall be well-graded, from the smallest to the largest size. Stone shall be obtained from an approved source and samples submitted to the Department for petrographic examination for durability prior to use.

The gradation of the stone shall be controlled by visual inspection. Two sample stockpiles of stone, at least 5 tons (metric tons) each or one-half the Project quantity, whichever is smaller, shall be used as a reference for judging the size and gradation of the stone supplied and placed. One sample shall be supplied at the construction site and one at the quarry. The construction site sample may be incorporated into the work. The stone riprap identified on the Plans shall conform to the following requirements:



**Percent Passing (Square Openings) by Weight**

<i>NCSA* Rock Size</i>	<i>R-7</i>	<i>R-6</i>	<i>R-5</i>	<i>R-4</i>
30" (762 mm)	100**	---	---	---
24" (610 mm)	---	100**	---	---
18" (457 mm)	15 - 50	---	100**	---
12" (305 mm)	---	15 - 50	---	100**
9" (229 mm)	0 - 15	---	15 - 50	---
6" (152 mm)	---	0 - 15	---	15 - 50
4" (102 mm)	---	---	0 - 15	---
3" (76 mm)	---	---	---	0 - 15

\*National Crushed Stone Association

\*\*Maximum allowable rock size

**712.05 Geotextile.** Geotextile for riprap shall conform to the requirements of Subsection 827.06.

**CONSTRUCTION METHODS.**

**712.06 Pre-Sacked Concrete Riprap.** If not installed the same day of delivery, the pre-sacked concrete riprap shall be protected from moisture by a waterproof covering such as polyethylene. Prior to installation, bags containing material which has begun to hydrate due to prolonged storage, inadequate protection, or other causes will be rejected by the Department and shall be replaced by the Contractor.

Pre-sacked riprap shall be placed on slopes for protection. The bagged riprap shall be laid with staggered joints, in a regular pattern, and tamped into place to cause them to conform to the prepared slope and to adjacent bags in place. Bags ripped or torn in placing shall be removed and replaced with sound, unbroken bags. The bagged riprap shall then be thoroughly wetted by hosing, sprinklers, or other approved methods capable of providing sufficient water to saturate the entire installation and initiate the cement hydration process. Where more than one course of bagged riprap is specified, each new course shall be thoroughly wetted as described above, before the next course is placed. In multi-level construction, all joints shall be clean, and intimate bag to bag contact will be required to ensure good bonding. Every effort shall be made to avoid disturbing the placed bags until the concrete has sufficiently set. During hot and dry weather, additional water curing may be required to sustain the hydration process.

**712.07 Stone Riprap.** Riprap shall be placed in accordance with this Section, to the dimensions and at the locations shown on the Plans or as established by the Engineer.

The area for placement of the stone riprap shall be excavated to the required placement depth. The area shall be in a relatively smooth condition, free from large stone, vegetation, debris, and areas of soft material. Preparation of the area may include, but is not limited to, excavating, removing unsuitable material, backfilling, placing embankment, and clearing and grubbing. The geotextile shall be placed on the prepared area in a loose and unstretched condition to minimize tearing and shifting. The adjacent edges of the fabric shall be joined with a lock-type or chain-type stitch folded seam or overlapped a minimum of 12" (305 mm), if permitted. The overlap direction shall be upstream over downstream and upslope over downslope. The fabric shall be anchored in place by securing pins or other acceptable methods. The fabric shall be covered as soon as possible so that it is not exposed for more than two weeks.

The riprap shall be carefully placed on the geotextile to produce an even distribution of pieces, with a minimum of voids and without tearing the geotextile. The riprap shall be placed to the full-course thickness in a manner which prevents segregation of stone sizes and which prevents displacement of underlying material. If necessary, individual stones shall be rearranged to ensure a uniform distribution.

**712.08 Method of Measurement.** The quantity of pre-sacked concrete riprap will be measured as the actual number of cubic yards (cubic meters) of riprap incorporated into the finished construction and accepted. The quantity of stone riprap will be measured as either the actual number of square yards (square meters) or the actual number of tons (metric tons) of riprap for each class placed and accepted. If stone riprap is measured by the square yard (square meter), the quantity will be determined by computations based on field measurements taken on and along the completed finished surfaces (no horizontal projection) and the specified placement thickness for the class. If stone riprap is measured by the ton (metric ton), the weight will be determined as specified in Subsection 109.01.

**712.09 Basis of Payment.** The quantity of pre-sacked concrete riprap will be paid for at the Contract unit price per cubic yard (cubic meter). The quantity of stone riprap will be paid for at the Contract unit price per square yard (square

meter) or ton (metric ton). Price and payment will constitute full compensation for excavating and preparing the bedding areas if applicable; for furnishing, preparing, and placing all materials, except for geotextile; for replacing rejected bags; and for all labor, equipment, tools, and incidentals required to complete the work.

Payment for geotextile will be made under the appropriate Section.

## **SECTION 713 GEOTEXTILES**

**713.01 Description.** This work consists of furnishing and placing geotextiles.

### **Materials.**

**713.02 Stabilization.** Geotextile for stabilization shall conform to the requirements of AASHTO M 288, Class 1.

**713.03 Separation.** Geotextile for separation shall conform to the requirements of AASHTO M 288, Class 2.

**713.04 Riprap.** Geotextile for placement under riprap shall conform to the requirements of Subsection 827.06.

**713.05 Construction Method.** Geotextile shall be placed in conformance with Subsection 712.07 unless specified otherwise on the Plans.

**713.06 Method of Measurement.** The quantity of geotextile will be measured as the actual number of square yards (square meters) for each type of geotextile placed and accepted. The quantity will be determined by computations based on field measurements taken on and along the geotextile covered surface.

**713.07 Basis of Payment.** The quantity of geotextile will be paid for at the Contract unit price per square yard (square meter). Price and payment will constitute full compensation for furnishing and placing all materials including anchoring devices, and for all labor, equipment, tools, and incidentals required to complete the work.

## **SECTION 714 DITCHING**

**714.01 Description.** This work consists of excavating lateral and longitudinal ditches. This work also includes clearing alongside the ditches, as necessary.

**714.02 Construction Methods.** Ditches shall be excavated as shown on the Plans. All material excavated from the ditches shall be spread on top of the land on each side of the ditch, graded to conform to the surface contours, and blended into the surrounding ground. Where necessary, the land shall be prepared and conditioned in all sections along both sides of the ditch to the width necessary to receive the material. As necessary, the Contractor shall clear the brush alongside the ditches. Brush shall be disposed as specified in Subsection 106.09.

**714.03 Method of Measurement.** The quantity of ditching will be measured in linear feet (linear meters) along the centerline of the ditch, constructed and accepted.

**714.04 Basis of Payment.** The quantity of ditching will be paid for at the Contract unit price per linear foot (linear meter). Price and payment will constitute full compensation for clearing, disposing of debris, excavating, and grading and for all labor, materials, equipment, tools, and incidentals required to complete the work.

## **SECTION 715 PERFORATED PIPE UNDERDRAINS**

**715.01 Description.** This work consists of constructing and performing a video inspection of underdrains from perforated, corrugated metal pipe or perforated, corrugated polyethylene tubing.

### **MATERIALS.**

**715.02 Perforated, Corrugated Metal Pipe.** Perforated, corrugated metal pipe shall conform to the requirements of AASHTO M 36/M 36M, Class 1.

**715.03 Perforated, Corrugated Polyethylene Tubing (CPT).** Perforated CPT shall conform to the requirements of AASHTO M 252, and shall be supplied in individual lengths no shorter than 10' (3 m). Coil pipe will only be permitted in 4" (102 mm) diameter, when it is to be machine installed.

**715.04 Stone.** Stone for backfill shall conform to the requirements of Section 813, Delaware 'o. 8.

**715.05 Filter Fabric.** Filter fabric shall conform to the requirements of AASHTO M 288.

#### **CONSTRUCTION METHODS.**

**715.06 General.** The underdrain shall be constructed in accordance with the details shown on the Plans or the Standard Construction Details and at the locations shown on the Plans. The pipe shall be placed as directed by the Engineer. Lateral connections to the pipe shall be made with connectors recommended by the manufacturer. Stone backfill shall be placed in 6" (150 mm) lifts and compacted with a vibratory plate to the satisfaction of the Engineer.

**715.07 Video Inspection.** After completion of the roadway base and prior to the Project's final inspection, the entire underdrain system shall be videoed. The entire underdrain system involved shall be numbered and then inspected by means of a closed-circuit television. The inspection will be done one section at a time in the presence of the Department's inspector.

The television camera used for the inspection shall be specifically designed and constructed for such inspection, capable of producing color video. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing quality to the satisfaction of the Department. If unsatisfactory, the equipment shall be removed and replaced.

The camera shall be moved through the pipe run in either direction at a speed of 2 to 3"/s (0.05 to 0.08 m/s) but in no case greater than 6"/s (0.15 m/s). Manual winches, power winches, television cable and power rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the pipe condition shall be used to move the camera through the pipe.

When manually operated winches are used to pull the television camera through the pipe run, telephones or other means of communication shall be used to ensure good communications between members of the crew pulling the camera.

The technician operating the camera shall be experienced and qualified in conducting video pipe inspections. The technician shall have the capability of controlling the movement of the television camera, adjusting the brightness of the built-in lighting system, and focusing the television camera by remote control. The importance of accurate distance measurements is emphasized. A distance meter and location indicator shall appear on the monitor and video tape indicating the exact location of the camera in the pipe between two structures.

The view scanned by the television camera shall be transmitted to a color monitor of not less than 12" (300 mm), measured diagonally across the screen. The monitor shall be located such that the Department's inspector has full visual access.

The technician shall stop and document on a separate written report and on audio any unusual conditions including but not limited to crushed pipe, open joints, obstructions, debris, roots, sharp bends, sags, and water pockets. A copy of this written report shall be supplied to the Department along with the visual and audio record on a good quality VHS videotape in a hard plastic case which will become the property of the Department.

The videotape will be evaluated by the Engineer for the purpose of acceptance of the underdrain system. Any defects noted shall be repaired by the Contractor.

**715.08 Method of Measurement.** The quantity of perforated pipe underdrains will be measured from end-to-end in linear feet (linear meters) of pipe completed and accepted.

**715.09 Basis of Payment.** The quantity of perforated pipe underdrains will be paid for at the Contract unit price per linear foot (linear meter). Price and payment will constitute full compensation for furnishing and placing all materials, including perforated pipe, connectors, stone for backfill, and filter fabric; for constructing perforated pipe drains; for excavating, backfilling, compacting, and video inspection; and for all labor, tools, equipment, and incidentals required to complete the work. If rock is encountered during excavation for perforated pipe underdrain, payment for rock removal will be made under Section 206.

## **SECTION 716 CONVERTING DRAINAGE INLETS TO JUNCTION BOXES**

**716.01 Description.** This work consists of placing a reinforced concrete cover on an existing drainage inlet and salvaging and stockpiling gratings.

**716.02 Materials.** Portland cement concrete shall conform to the requirements of Section 812, Class B. Bar reinforcement shall conform to the requirements of Section 824.

**716.03 Construction Methods.** The existing drainage inlet frame and grate shall be removed. A reinforced concrete cover shall be constructed and placed directly bearing on the drainage inlet walls.

**716.04 Method of Measurement.** The quantity of drainage inlets converted to junction boxes will be measured as the actual number of drainage inlets converted to junction boxes, placed and accepted.

**716.05 Basis of Payment.** The quantity of drainage inlets converted to junction boxes will be paid for at the Contract unit price per each. Price and payment will constitute full compensation for constructing and placing the concrete cover; for furnishing and placing all materials, including bar reinforcement; for salvaging and stockpiling gratings; and for all labor, equipment, tools, and incidentals required to complete the work.

## **SECTION 717 PERMANENT ROADWAY DRAINS**

**717.01 Description.** This work consists of constructing permanent roadway drains.

**717.02 Materials.** The material used for backfilling the permanent roadway drains shall conform to the requirements of Section 813, Delaware No. 8.

### **CONSTRUCTION METHODS**

**717.03 Preparation.** Before excavation for the permanent roadway drains begins, the foundation of the roadway and the shoulder shall be properly shaped, uniformly and thoroughly compacted, and maintained as established in Section 202.

The side ditches shall be acceptable to the Engineer prior to beginning the excavation for the permanent roadway drains.

**717.04 Construction of Drains.** All materials removed in the work of constructing permanent roadway drains shall be used in the formation of embankments, shoulders, and slopes unless the Engineer classifies the excavated material as unsuitable for re-use, whereupon the material shall become the property of the Contractor and be disposed of as specified in Subsection 106.09.

The permanent roadway drains shall be constructed through the shoulder toward the side ditches as extensions of the graded aggregate base course. The ditches shall be constructed at intervals not to exceed 300' (90 m), unless otherwise designated on the Plans, and at all low points in the grade and at other points as established by the Engineer. The permanent roadway drains shall be at least 12" (300 mm) in width and have a constant slope from the base course to the side ditch.

The Contractor shall conduct its operations in such a manner that the Engineer can take the necessary measurements before any backfill is placed. The excavated ditches shall be backfilled with approved material for a minimum thickness equal to that of the graded aggregate base course.

**717.05 Performance Requirements.** The permanent roadway drains shall be constructed to ensure adequate drainage of water from the graded aggregate base course to the side ditches.

**717.06 Method of Measurement.** The quantity of permanent roadway drains will be measured as the number of linear feet (linear meters) of permanent roadway drains accepted by the Engineer, measured along the centerline length of the bottom of the ditch from the nearest edge of the graded aggregate base course to the nearest edge of the side ditch. Work and materials required for Subsection 717.03 will not be measured.

**717.07 Basis of Payment.** The quantity of permanent roadway drains will be paid for at the Contract unit price per linear foot (linear meter). Price and payment will constitute full compensation for preparing, excavating, and disposing

or re-using of the excavated material; for furnishing and placing the backfill material; and for all equipment, tools, labor, and incidentals required to complete the work.

## **SECTION 718 ROOF DRAINS**

**718.01 Description.** This work consists of furnishing pipe for outlets and roof drains and furnishing and constructing connections to pipes, drainage inlets, and endwalls.

### **MATERIALS.**

**718.02 Polyvinyl Chloride Pipe (PVC).** PVC pipe shall meet the requirements of ASTM D 3034, Type PSM. The acceptable standard thermoplastic pipe dimension ratios (SDR) are SDR-35 and SDR-41. The pipe and fittings shall be made of PVC plastic. The two joining systems are:

- a. Solvent cement joints.
- b. Elastomeric gasket joints: Assembly shall be in accordance with the pipe manufacturer's recommendations.

**718.03 Steel.** Steel pipe shall conform to the requirements of ASTM A 53 and shall be galvanized in accordance with AASHTO M 111/M 111M.

**718.04 Construction Methods.** The portion of roof drain under the sidewalk or connecting to the curb and gutter shall be 3" (80 mm) diameter steel pipe and shall be connected to the curb as shown on the Standard Construction Details. All remaining roof drains shall be PVC pipe.

The Contractor may use PVC pipe for the entire length including under sidewalk or curb if the connecting curb or gutter are Portland cement concrete curb Type 1 or Type 2; or integral Portland cement concrete curb and gutter Type 1 or Type 3.

All pipe shall be laid in accordance with Subsection 612.08. Joints shall be finished in accordance with the pipe manufacturer's recommendations.

Backfilling of pipe trenches shall be as specified under Section 208.

When an existing sidewalk must be replaced over a roof drain, an expansion joint shall be constructed over the centerline of the pipe.

**718.05 Method of Measurement.** The quantity of roof drains will be measured as the actual number of linear feet (linear meters) of pipe, including 3" (80 mm) steel pipe and specially manufactured connections, measured from end to end of pipe, excluding structures, installed and accepted.

**718.06 Basis of Payment.** The quantity of roof drains will be paid for at the Contract unit price per linear foot (linear meter). Price and payment will constitute full compensation for furnishing and installing all pipe; for excavation, backfilling, and compaction of trenches; and for all materials, tools, and incidentals required to complete the work.

## **SECTION 719 RESERVED**

## **GUARDRAIL AND FENCING**

### **SECTION 720 GALVANIZED STEEL BEAM GUARDRAIL**

**720.01 Description.** This work consists of furnishing and erecting galvanized steel beam guardrail.

**720.02 Materials.** All materials for galvanized steel beam guardrail shall conform to the requirements of the following Section and Subsection:

Portland Cement Concrete, Class B	812
Steel Posts, Steel Offset Blocks, and Steel Shapes	828.02
Beams, Type II	828.02
Hardware	828.02
Rods and Turnbuckles	828.02
Reflectorized Washers	828.02
Timber Posts and Timber Offset Blocks	828.02

**720.03 Construction Methods.** Posts shall be set plumb, true to the line and grade shown on the Plans, or as directed.

Guardrail shall be erected to form a smooth, continuous rail conforming to the required line and grade. All bolts, except through expansion joints, shall be drawn tight. Bolts through expansion joints shall be drawn up as tight as possible without preventing the beams from sliding past one another longitudinally. Bolts shall extend at least 3" (6 mm) beyond the nuts. Bolts which are necessary for adjustment shall not extend more than 2" (13 mm) beyond the nuts. The Contractor shall be required to burr the last thread of post railing bolts to prevent removal of such bolts. All hot-mix bituminous pavement that cracks or breaks as a result of installing guardrail posts shall be repaired in accordance with the requirements in Section 406.

Reflectorized washers shall be installed in accordance with the Standard Construction Details. Reflectorized washer colors shall be as follows:

- a. On any divided highway or one way ramp, the surface facing traffic shall be white or silver on the right side and yellow on the left side. The back surface of all of the washers shall be red.
- b. On any undivided highway, all reflectorized washer surfaces shall be white or silver on the front and back.

**720.04 Method of Measurement.** The quantity of galvanized steel beam guardrail will be measured as the number of linear feet (linear meters) of guardrail installed and accepted. Guardrail will be measured from the center of end post to the center of end post, excluding barrier connections and end treatments. The quantity of guardrail components furnished and installed will be measured as the number of each component. The quantity of guardrail over culverts will be measured as the number of each installed and accepted.

**720.05 Basis of Payment.** The quantity of galvanized steel beam guardrail will be paid for at the Contract unit price per linear foot (linear meter) of guardrail. The quantity of guardrail components will be paid for at the Contract unit price per each component. The quantity of guardrail over culverts will be paid for at the Contract unit price per each. Price and payment will constitute full compensation for furnishing and placing all materials, including reflectorized washers; for burring of bolts; for excavating, backfilling, compacting, and disposing of surplus materials; for patching hot-mix around posts; and for all labor, equipment, tools, and incidentals required to complete the work.

## **SECTIONS 721 through 724 S RESERVED**

### **SECTION 725 GUARDRAIL-TO-BARRIER CONNECTION (APPROACH AND EXIT TYPES)**

**725.01 Description.** This work consists of furnishing and erecting approach and exit type guardrail-to-barrier connections.

**725.02 Materials.** The materials for guardrail-to-barrier connections shall conform to the requirements of the following Subsection:

Beams, Type I	828.02
Hardware	828.02
Reflectorized Washers	828.02
Timber Blocks and Timber Offset Blocks	828.02

**725.03 Construction Methods.** Construction methods shall conform, as applicable, to the requirements of Section 720. In addition, the Contractor shall exercise great care so as not to chip, crack, or otherwise damage the concrete barrier while drilling holes in the barrier and attaching the guardrail.

**725.04 Method of Measurement.** The quantity of guardrail-to-barrier connections will be measured as the number of each guardrail-to-barrier connection.

**725.05 Basis of Payment.** The quantity of guardrail-to-barrier connections will be paid for at the Contract unit price for each guardrail-to-barrier connection. Price and payment will constitute full compensation for furnishing and placing all materials, including reflectorized washers; for burring of bolts; for excavating, backfilling, compacting, and disposing of surplus materials; for patching hot-mix around posts; for repairing any damage to the concrete barrier that resulted from the process of attaching the guardrail to the barrier; and for all labor, equipment, tools, and incidentals required to complete the work.

## **SECTION 726 GUARDRAIL END TREATMENT**

**726.01 Description.** This work consists of furnishing and erecting guardrail end treatments.

**726.02 Materials.** All materials for guardrail end treatment shall conform to the requirements of the following Section and Subsection:

Portland Cement Concrete, Class B	812
Steel Posts, Steel Offset Blocks, and Steel Shapes	828.02
Beams, Type II	828.02
Hardware	828.02
Swaged Cable Assemblage	828.02
Reflectorized Washers	828.02
Timber Posts and Timber Offset Blocks	828.02

**726.03 Construction Methods.** Construction methods shall conform, as applicable, to the requirements of Section 720.

**726.04 Method of Measurement.** The quantity of guardrail end treatment will be measured as the number of each guardrail end treatment.

**726.05 Basis of Payment.** The quantity of guardrail end treatments will be paid for at the Contract unit price per each end treatment. Price and payment will constitute full compensation for furnishing and installing all materials, including reflectorized washers; for burring of bolts; for excavating, backfilling, compacting, and disposing of surplus materials; and for all labor, tools, equipment, and incidentals required to complete the work.

## **SECTION 727 FENCES AND GATES**

**727.01 Description.** This work consists of furnishing and erecting chain-link and right-of-way fence and gates, and resetting and repairing chain-link fence.

**727.02 Materials.** All materials for fences and gates shall conform to the requirements of the following Section and Subsections:

Portland Cement Concrete, Class B	812
Right-Of-Way Fence:	
Metal Posts	825.02
Barbed Wire	825.02
Woven Wire Fabric	825.02
Chain-Link Fence:	
Chain-Link Fabric	825.03
Posts	825.03
Top Rails	825.03
Horizontal Braces	825.03
Gate Frames	825.03
Undersized Members	825.03
Alternate Coating	825.03
Tension Wire	825.03
Miscellaneous Hardware	825.03

**727.03 Fabrication.** Fabrication of materials furnished under this Section shall conform to the sizes, shapes, dimensions, and other factors shown on the Plans and shall show careful, finished workmanship in all respects.

**727.04 Markings.** Each roll of fence fabric shall carry a tag showing the type of base metal (steel or aluminum alloy number), type of coating, class of coating, the diameter of the wire, the length of fencing in the roll, and the name or mark of the manufacturer. Posts, wire, and other fittings shall be identified as to manufacturer, type of base metal (steel or aluminum alloy number), class or coating, and other pertinent data sufficient for proper identification and verification of conformance to the requirements of Section 825

**727.05 Inspection.** Each product or item furnished shall be subject to inspection at the factory and the fabricating plant, in laboratories of the Department's choosing, and at all other points of delivery.

## **CONSTRUCTION METHODS.**

**727.06 Removal of Obstructions.** Before starting fence construction, all trees, brush, old fences, and other obstacles that interfere with the proper construction of the fence shall be removed in accordance with Section 201.

**727.07 Concrete Footings.** Concrete footings shall be constructed in accordance with the dimensions shown on the Standard Construction Details. All posts, except line posts for right-of-way fence, shall be set in concrete. Posts shall be centered in the footing. The concrete shall be thoroughly compacted around the posts by tamping or vibrating, and shall be slightly higher than the ground line. The top surface of the footings shall be smooth and sloped to drain moisture away from the posts. No attachments shall be placed on the posts, and no posts shall be disturbed in any manner, within 72 hours after the concrete footing is completed. Hand mixed concrete shall not be used, unless approved.

**727.08 Rock Excavation.** When rock is encountered at a depth less than the planned concrete footing depth, a hole 2" (50 mm) in diameter larger than the greatest dimension of the post cross-section shall be drilled to a depth of 12" (300 mm), into the rock. After the post is set, the remainder of the drilled hole shall be filled with grout, composed of one part Portland cement and two parts mortar sand. Any remaining space above the rock shall be filled with concrete in the manner described in Subsection 727.07 for post footings. All excess excavation from footings shall be disposed of in a manner satisfactory to the Engineer.

## **727.09 Posts, Rails, and Braces.**

- a. *Chain-Link Fence.* Posts for chain-link fence shall be plumb and spaced at 10' (3 m) centers maximum, with a tolerance of -2' (-0.6 m). Spacing of posts shall be as uniform as practicable under local conditions. Terminal posts shall be installed at all abrupt changes in grade, at changes in line direction over 15 degrees, and at all ends. In no case shall the distance between terminal posts exceed 500' (150 m).

Top rail shall pass through intermediate post tops and form a continuous brace from end to end of each stretch of fence. Top rail is to be fastened to terminal posts with heavy pressed steel connectors.

Couplings used to join the top rail segments shall allow for expansion. Expansion devices shall be approved by the Engineer. Couplings are to be placed approximately every 20' (6 m).

Horizontal brace rails, with diagonal truss rods and turnbuckles, shall be installed at all terminal posts. Sufficient braces shall be applied to allow complete bracing from each terminal post to adjacent line posts. Roll formed rail and brace shall be installed 2' (600 mm) apart and the tubular rail and brace shall be installed 2' - 6" (750 mm) apart. Rail and brace shall extend from the terminal post to the first adjacent line post. Braces shall be fastened to the posts by heavy pressed steel connections, then trussed from the line posts back to the terminal post with round rods as shown on the Standard Construction Details.

When barbed wire is required, posts shall be equipped with extension arms. The arms shall extend at a 45 degree angle. Lock-wires, securely fastening the barbed wire, shall be equally spaced along the extension arm. The top strand shall be located 12" (300 mm) above the fabric and 12" (300 mm) out from the fence line. Extension arms shall be capable of supporting a dead load of 200 lb (90 kg) at the top strand attachment point, without permanently deforming.

- b. *Right-Of-Way Fence.* Metal posts for right-of-way fence shall be plumb and spaced 12' (3.5 m) apart, unless otherwise shown on the Plans. Posts shall be firmly embedded in the ground to a depth of at least 2' - 6" (750 mm).

Metal post braces shall be firmly attached to metal end posts, intermediate end posts, corner posts, and gate posts. Metal posts and braces shall be set in concrete footings, as indicated on the Standard Construction



Details. Corner posts and intermediate end posts shall be provided with two braces, one each way from the post in the main line of the fence. End posts and gate posts shall be provided with one brace in the line of the fence. Line posts shall be braced in both directions as described above at intervals of not more than 500' (150 m).

## **727.10 Gates.**

### **a. Chain Link Fence.**

1. *Vehicular Gates.* Gate frames shall be made of steel pipe according to the requirements of ASTM A 53, with an outside diameter of 1.90" (48.3 mm) and a nominal weight of 2.72 lb/ft (4.05 kg/m). Corners shall be heavy malleable iron or pressed steel fittings, securely riveted or welded. Welds shall be painted with aluminum base or zinc base paint.

Fabric to match the fence shall be installed in the frame by means of tension bars and hook bolts. Each frame shall be equipped with 3/8" (10 mm) diameter adjustable truss rods. Bottom hinges shall be ball and socket type, designed to carry the weight of the gate on the post footing. The upper hinge shall be a wrap-around adjustable type. All gates shall be equipped with a positive type latching device, with a provision for padlocking. All drive gates are to be provided with a center plunger rod, and catch and semi-automatic outer catches to secure the gate in the opened position. Vehicular gates shall be capable of being operated by one person and shall be able to swing open 180 degrees.

The bottom of vehicular gates shall be 3 to 5" (75 to 125 mm) above the ground when closed and shall be at least 3" (75 mm) above ground at all points of swing. The Contractor shall modify the existing grade within the area of the swing, if necessary, to meet this requirement, when directed.

2. *Walk Gates.* Walk gates shall be 4' (1.2 m) in width. The walk gate height shall be as shown on the Standard Construction Details or as indicated in the Special Provisions.

Walk gates shall be equipped with approved latches, stops, locking devices, and approved devices to allow for padlocking.

The bottom of walk gates shall be 3 to 5" (75 to 125 mm) above the ground when closed and shall be at least 3" (75 mm) above ground at all points of swing. The Contractor shall modify the existing grade within the area of the swing, if necessary, to meet this requirement, when directed.

### **b. Right-Of-Way Fence.**

1. *Vehicular Gates.* Vehicular gates shall be equipped with approved latches, stops, locking devices, and approved devices to allow for padlocking and for securing and supporting the free end of vehicular gates in the open position to prevent damage to the gates or fence by over-swing. All gate stops shall be of the type shown on the Plans or an alternative as approved by the Engineer and shall be set in concrete as shown on the Standard Construction Details. Hinges shall be of the pivot type, heavy duty, with large bearing surfaces. Hinges shall clamp onto posts and shall not twist or turn under the action of gates. Hinges shall be configured such that closed gates cannot be lifted off their hinges. Vehicular gates shall be capable of being operated easily by one person and shall be able to swing open 180 degrees.

The bottom of vehicular gates shall be 3 to 5" (75 to 125 mm) above the ground when closed and shall be at least 3" (75 mm) above ground at all points of swing. The Contractor shall modify the existing grade within the area of the swing, if necessary, to meet this requirement, when directed.

2. *Walk Gates.* Walk gates shall be 4' (1.2 m) in width. The walk gate height shall be as shown on the Standard Construction Details or as specified in the Special Provisions.

Walk gates shall be equipped with approved latches, stops, locking devices, and approved devices to allow for padlocking.

The bottom of walk gates shall be 3 to 5" (75 to 125 mm) above the ground when closed and shall be at least 3" (75 mm) above ground at all points of swing. The Contractor shall modify the existing grade within the area of the swing, if necessary, to meet this requirement, when directed.

#### **727.11 Fence Construction.**

- a. *General.* Fence shall be erected at the locations indicated on the Plans. The fence shall be true to line, taut, and shall comply with the best practice for fence construction. Fence fabric shall be installed on the roadway side of posts. The bottom of the fabric shall be placed a nominal distance of 3" (75 mm) above the ground line; however, over irregular ground a minimum clearance of 1" (25 mm) and a maximum clearance of 6" (150 mm) will be permitted for a horizontal distance not to exceed 8' (2.4 m). Any excavation and backfilling required to comply with these provisions shall be made.

Tension wire shall be secured to fence posts using chain-link bands. The wire shall be attached to the fence using hog rings spaced at approximately 24" (600 mm) on center as shown on the Standard Construction Details.

At locations of small natural swales or drainage ditches, and where it is not practical to have the fence conform to the general contour of the ground surface, such that the distance between the bottom of the fence and the ground surface exceeds 6" (150 mm), the opening below the fence shall be spanned with barbed wire as shown on the Standard Construction Details.

Existing fences shall be permanently fastened to terminal posts of the new fence, at the location indicated on the Plans.

- b. *Chain-Link Fence.* Fabric shall be attached to the line posts with 6 gage (5 mm) wire clips spaced approximately 14" (350 mm) apart, and attached to the top rail and brace rail with 9 gage (3 mm) tie wires on approximately 24" (600 mm) centers. End connectors shall be as close to the ends of the fabric as possible. The chain-link fabric shall be securely fastened to all terminal posts with 3/16 by 3/4" (5 by 19 mm) tension bars and 11 gage (3 mm) pressed bands spaced approximately 14" (350 mm) apart, or the fabric shall be woven integrally into lock loops on roll form sections.
- c. *Right-Of-Way Fence.* Fabric shall be installed according to the Standard Construction Details.

**727.12 Chain-Link Fence Resetting.** Chain-link fence resetting shall conform as close as practical to the requirements of this Section. Fences shall be reset true to the line and grade shown on the Plans, or as determined by the Engineer. The elevation of the top of the fences shall be uniform. Chain-link fence material shall be new and conform to the requirements of Subsection 727.02, unless older types are necessary to maintain good appearances. Lost or damaged materials shall be replaced. Necessary grading to accomplish these requirements shall be performed by the Contractor.

**727.13 Electrical Grounds.** Electrical grounds shall be installed at intervals of no more than 2000' (600 m) in all lines of fence and directly below all locations where a power line passes over the fence. Grounding shall be accomplished with a copper clad rod 8' (2.4 m) long and a minimum of 5/8" (16 mm) in diameter. The rod shall be driven vertically until the top is approximately 6" (150 mm) below the top of the soil surface. A No. 6 solid copper conductor shall be clamped to the rod and to the fence, in such a manner that each element of the fence is grounded.

#### **727.14 Method of Measurement.**

- a. *Fence.* The quantity of fence will be measured by the linear foot (linear meter) along the actual fence, excluding gates, constructed and accepted.
- b. *Reset Fence.* The quantity of chain-link fence reset and repaired will be measured as the actual number of linear feet (linear meters) of fence repaired and reset by the Contractor, measured along the fence.
- c. *Gates.* The quantity of gates will be measured as the number of each type fabricated, installed, and accepted.

## 727.15 Basis of Payment.

- a. *Fence*. The quantity of fence will be paid for at the Contract unit price per linear foot (linear meter) for each type of fence.
- b. *Resetting Fence*. The quantity of chain-link fence reset and repaired, including all posts and gates, will be paid for at the Contract unit price per linear foot (linear meter) for fence reset. Portions of fence which are entirely new will be paid for at the Contract unit price for new fence.
- c. *Gates*. The quantity of gates will be paid for at the Contract unit price for each type of gate.

Price and payment for work in Subsection 727.15 (a), (b), and (c) will constitute full compensation for clearing and grading the line of fence; for furnishing and erecting new fences, gates, and all posts; for excavating and backfilling for footings; for furnishing and placing concrete for footings; for furnishing and installing all materials, including fittings, hardware, and grounds; and for all labor, equipment, tools, and incidentals required to complete the work

## SECTIONS 728 through 731 S RESERVED

## LANDSCAPING AND EROSION CONTROL

### SECTION 732 TOPSOIL

**732.01 Description.** This work consists of furnishing and placing topsoil for planting.

**732.02 Materials.** Topsoil shall be original surface friable loam topsoil of uniform quality and free from heavy clay, frozen clods, lumps, plants, roots, sticks, and foreign materials harmful to plant growth, such as fragments of hot-mix, concrete pavement, and surface treatment.

Topsoil shall be reasonably free of noxious perennial weeds or wood vegetation and completely void of Johnsongrass (*Sorghum halapense*) as determined through prior inspection by an authorized representative of the Department.

Topsoil shall have an acidity range of pH 6.0 to pH 7.5, and, if necessary, lime shall be applied, as directed by the Engineer, and incorporated with the furnished topsoil.

Topsoil shall contain not less than 2% nor more than 30% organic matter as determined in accordance with AASHTO T 194.

The method of testing topsoil shall be in accordance with the requirements of AASHTO T 88, Modified; AASHTO T 89,

Method B; and AASHTO T 90; and shall meet the following gradation requirements:

<b>Gradation Requirements</b>		
<b>Minimum Percent Passing</b>		
<i>Sieve Size</i>	<i>by Weight</i>	
2" (50 mm)	100	
No. 4 (4.75 mm)	90	
No. 10 (2.00 mm)	80	
	<b>Minimum Percent</b>	<b>Maximum Percent</b>
Passing No. 10 (2.00 mm) and retained on No. 200 (75 µm) sieve		
Sand	15	65
	Passing No. 200 (75 µm) sieve	
Silt	10	60
Clay	5	40

Topsoil shall not be delivered until samples have been approved by the Engineer.

**732.03 Areas From Which Obtained.** Topsoil shall be secured from areas from which topsoil has not been previously removed either by erosion or mechanical methods, and it shall not be removed to a depth in excess of the depth approved.

The area or areas from which topsoil is secured shall possess such uniformity of material depth, color, texture, drainage, and other characteristics as to offer assurance that when removed in commercial quantities, the product is homogeneous in nature and conforms to the requirements of this Section.

## **CONSTRUCTION METHODS.**

**732.04 Clearing the Area.** All areas from which topsoil is to be secured shall be cleaned of all brush, sticks, weeds, stones, bricks, ashes, and other refuse which may hinder or prevent growth.

**732.05 Approval of Materials.** In securing topsoil from an approved source, should strata or seams of materials be encountered which do not qualify as topsoil, such materials shall be removed from the topsoil or, if required, the source shall be abandoned.

**732.06 Placing.** Before placing or depositing topsoil upon any section as shown on the Plans, the foundation upon which the topsoil is to be placed shall be approved.

Topsoil shall be spread on these areas to a depth sufficiently greater than that specified on the Plans, so that after natural settlement has taken place the work shall conform to the elevations on the Plans.

**732.07 Maintaining the Topsoil.** The Contractor shall maintain the topsoil until final completion and acceptance of the Contract. Maintenance shall consist of preserving, protecting, replacing, and such other work as may be necessary to keep the topsoil in a satisfactory condition.

**732.08 Final Cleaning.** Upon the completion of this work, final cleaning shall be done within the limits of the Project and shall consist of completely cleaning the Project of excess material, sweeping pavements and structures of dirt and rubbish, and removing of any unused material which may mar the appearance of the Project.

**732.09 Method of Measurement.** The quantity of topsoil will be measured as the number of square yards (square meters) of topsoil furnished, placed, and accepted only in the areas shown on the Plans or where directed. Measurements will be made along the surfaces of the completed topsoiled areas.

**732.10 Basis of Payment.** The quantity of topsoil will be paid for at the Contract unit price per square yard (square meter). Price and payment will constitute full compensation for preparing the grade; for furnishing, hauling, and placing all materials, including necessary quantities of lime; for maintaining topsoil; and for all labor, equipment, tools, and incidentals required to complete the work.

## **SECTION 733 TOPSOILING**

**733.01 Description.** This work consists of refertilizing and placing the topsoil which has been salvaged and stockpiled under Section 202.

**733.02 Materials.** Topsoil shall be stockpiled and salvaged under Section 202.

**733.03 Construction Methods.** The placement of topsoil shall conform to the requirements of Section 732. After placement, the Contractor shall refertilize the topsoil in accordance with Subsection 734.03 (a) and (b)(1). Refertilization shall occur a minimum of six months after the initial seeding.

**733.04 Method of Measurement.** The quantity of topsoiling will be measured as the number of square yards (square meters) of topsoil placed and accepted only in the areas shown on the Plans or where directed. Measurements will be made along the surfaces of the completed topsoiling areas.

**733.05 Basis of Payment.** The quantity of topsoiling will be paid for at the Contract unit price per square yard (square meter). Price and payment will constitute full compensation for preparing the grade; for hauling and placing all topsoil salvaged under Section 202; for maintaining topsoil; and for all labor, equipment, tools, and incidentals required to complete the work.

Refertilization will be incidental to the work in this Section.

## SECTION 734 SEEDING

**734.01 Description.** This work consists of furnishing and placing seed and soil supplements.

### MATERIALS.

**734.02 Water.** Water shall conform to the requirements of Section 803.

### 734.03 Soil Supplements.

- a. Limestone shall be ground agricultural limestone and shall contain not less than 85% calcium and magnesium carbonates. Dolomitic lime or magnesium lime shall contain at least 10% magnesium oxide. The limestone shall be ground to meet the following gradation:

<i><b>Sieve Size</b></i>	<i><b>Percent Passing</b></i>
No. 10 (2.00 mm)	100
No. 20 (850 µm)	90
No. 100 (150 µm)	50

- b. Fertilizer shall conform to the following mix requirements:

1. *Permanent Grass Seeding - Dry Ground, Wet Ground, and Subdivisions; and Temporary Grass Seeding - Dry Ground.*

- a. 70 lb/ac (78 kg/ha) nitrogen (N); 50% by weight of the nitrogen content shall be available from ureaformaldehyde.
- b. 42 lb/ac (47 kg/ha) available phosphate; phosphorous pentoxide ( $P_2O_5$ ) shall be the sum of the water soluble and the citrato-soluble phosphate.
- c. 28 lb/ac (31 kg/ha) water soluble potash; potassium oxide ( $K_2O$ )

2. *Permanent Crown Vetch Seeding.*

- a. 152 lb/ac (170 kg/ha) nitrogen (N), 100% by weight of the nitrogen content shall be available from ureaformaldehyde
- b. 100 lb/ac (112 kg/ha) available phosphate; phosphorous pentoxide ( $P_2O_5$ ) shall be the sum of the water soluble and the citrato-soluble phosphate.
- c. 100 lb/ac (112 kg/ha) water soluble potash; potassium oxide ( $K_2O$ )

- c. Commercial fertilizer shall be furnished in containers plainly marked with the chemical analysis of the product or, if provided in bulk, a certificate guaranteeing the fertilizer analysis must accompany each delivery to the Project. No fertilizer shall be used which has not been marketed in accordance with the State and Federal laws.
- d. The ureaformaldehyde specified above shall meet the following requirements:

1. The water insoluble nitrogen shall be at least 60% of the total nitrogen.
2. The activity index of the water insoluble nitrogen shall be either:

- a. not less than 40% by the Association of Official Analytical Chemists International (AOAC International) method for ureaformaldehyde products, or
- b. not less than 50% by the AOAC International alkaline permanganate method, or
- c. 80% by the AOAC International neutral permanganate method.

- e. Wood cellulose fiber shall be a processed wood product having uniform fiber characteristics which remains in uniform suspension in water under agitation and blends with seed, fertilizer, and other additives to form a homogeneous slurry.

The fiber shall perform satisfactorily in hydraulic seeding equipment without clogging or damaging the system. The slurry shall contain a green dye that provides easy visual inspection for uniformity of application.

#### 734.04 Grass and Agricultural Seeds.

- a. *Seeds.* All seed shall be fresh, clean, from new crop seed, and delivered to the site in original unopened packages in accordance with the Delaware Code and respective State laws.
- b. *Seed Inspection.*

1. Blended seed lots shall be mixed in the presence of an authorized representative of the Department. All such blended seed shall also display an official Department's inspection tag which has been sewn into or otherwise attached to the bag.

No seed shall be used after the expiration date placed on the official Department's inspection tag by an authorized representative of the Department.

2. With all single seed lots, the Contractor shall furnish to the Project inspector two copies of the certified mill analysis for the seed to be used. The Project inspector will compare the mill analysis with the mill tags sewn into the bags of seed for lot number, guaranteed analysis, and certification date.

If the mill tags and mill analysis data are identical and meet the Project requirements, single seed lots can be used on the basis of verification by the Project inspector.

If the entire bag of a single seed lot is not used, the weight of the seed used from the bag shall be so noted on the mill tag which shall be left intact on the bag. In addition, the Project inspector will also include the Contract number of the Project and the date on which the seed was used, and so verify the above with its signature on the mill tag. Partial bags which have the above information noted on the mill tag will be accepted for use on Department projects.

No seed shall be used which has a dated mill analysis or mill tag older than nine months.

- c. *Permanent and Temporary Seeding.* The Seeding Chart on the following pages shall be used for the following specified seeding:

- o Permanent Grass Seeding - Dry Ground,
- o Permanent Crown Vetch Seeding,
- o Permanent Grass Seeding - Wet Ground,
- o Permanent Grass Seeding - Subdivisions,
- o Temporary Grass Seeding - Dry Ground, and
- o Temporary Grass Seeding - Wet Ground.

Species	<b>Seeding Chart</b>				<b>Modification Factors for Seeding Rate</b> pounds per acre (kilograms per hectare)			<b>Modification Factors for Seeding Periods</b>	
	Max. % Weed Seeds <sub>7</sub>	Min. % Purity	Min. % Germination	Seeding Rate lb/ac (kg/ha)	Seeding Period A (2/16 to 4/15)	Seeding Period B (4/16 to 8/15)	Seeding Period C (8/16 to 2/15)	North District	Central and South Districts
<b>Permanent Grass Seeding - Dry Ground</b>									
Hard Fescue blend <sup>2</sup>	0.15	98	85	100 (113.0)	Add 5 lb/ac (6.0 kg/ha)	Add 4 lb/ac (5.0 kg/ha)	Add 5 lb/ac (6.0 kg/ha)		Add 3 lb/ac (4.0 kg/ha)
( <u>Festuca</u> <u>trachyphylla</u> )					Redtop	Korean or Kobe	Redtop		Weeping
	0.15	98	90	10	( <u>Agrostis</u> <u>alba</u> )	Lespedeza	( <u>Agrostis</u> <u>alba</u> )		Lovegrass

Seeding Chart				Modification Factors for Seeding Rate pounds per acre (kilograms per hectare)				Modification Factors for Seeding Periods	
Species	Max. % Weed Seeds 7	Min. % Purity	Min. % Germination	Seeding Rate lb/ac (kg/ha)	Seeding Period A (2/16 to 4/15)	Seeding Period B (4/16 to 8/15)	Seeding Period C (8/16 to 2/15)	North District	Central and South Districts
Perennial Ryegrass  ( <u>Lolium perenne</u> )				(12.0)	<u>alba</u>	( <u>Lespedeza</u> <u>stipulacea</u> )	<u>alba</u>  + 65 lb/ac (73.0 kg/ha)  Winter Rye  ( <u>Secale cereale</u> )  from 2/16 to 3/1		( <u>Eragrostis curvula</u> )  during Seeding  Period B <sup>8</sup>
Total Seed Quantity lb/ac (kg/ha)				110 (125.0)	180 (204.0)	114 (130.0)	180 (204.0)		117 (134.0)
				Permanent Crown Vetch Seeding					
Crown Vetch  ( <u>Coronilla varia</u> )	0.35	99	70 <sup>3</sup>	30 (34.0)	Add 65 lb/ac (73.0 kg/ha)	Add 4 lb/ac (5.0 kg/ha)	( <u>Agrostis alba</u> )		
variety: Penngift					Winter Rye  ( <u>Secale cereale</u> )	Korean or Kobe  Lespedeza  ( <u>Lespedeza</u> <u>stipulacea</u> )	+ 65 lb/ac (73.0 kg/ha)  Winter Rye  ( <u>Secale cereale</u> )		
Annual Ryegrass  ( <u>Lolium multiflorum</u> )	0.15	95	90	22 (25.0)	from 2/16 to 3/1		from 10/15 to  2/15		
Total Seed Quantity lb/ac (kg/ha)				52 (59.0)	117 (132.0)	56 (64.0)	122 (138.0)		
				Permanent Grass Seeding - Wet Ground <sup>4</sup>					
Redtop	0.75	95	90	40 (45.0)	Add 65 lb/ac (73.0		Add 65 lb/ac (73.0		

Seeding Chart				Modification Factors for Seeding Rate pounds per acre (kilograms per hectare)				Modification Factors for Seeding Periods	
Species	Max. % Weed Seeds 7	Min. % Purity	Min. % Germination	Seeding Rate lb/ac (kg/ha)	Seeding Period A (2/16 to 4/15)	Seeding Period B (4/16 to 8/15)	Seeding Period C (8/16 to 2/15)	North District	Central and South Districts
( <u>Agrostis alba</u> )					kg/ha)		kg/ha)		
Creeping Bentgrass	0.75	98	90	25 (28.0)	Winter Rye  ( <u>Secale cereale</u> )		Winter Rye  ( <u>Secale cereale</u> )		
( <u>Agrostis palustris</u> )					from 2/16 to 3/1		from 10/15 to 2/15		
	0.50	98	85	35 (40.0)					
Sheep Fescue <sup>5</sup>									
( <u>Festuca ovina</u> )	0.50	98	80	25 (28.0)					
Rough Stalked Bluegrass									
( <u>Poa trivialis</u> )									
Total Seed Quantity lb/ac (kg/ha)				125 (141.0)	190 (214.0)		190 (214.0)		
Permanent Grass Seeding - Subdivisions									
Hard Fescue blend <sup>2</sup>								Add 50 lb/ac (56.0 kg/ha)	
( <u>Festuca trachyphylla</u> )	0.15	98	85	100 (113.0)				Kentucky  Bluegrass	
Perennial Ryegrass	0.15	98	90	10 (12.0)				( <u>Poa pratensis</u> )	
( <u>Lolium perenne</u> )								during Seeding	
Total Seed Quantity lb/ac (kg/ha)				110 (125.0)				Periods A <sup>1</sup> , B <sup>1</sup> ,  and C <sup>1</sup>	
								160 (181.0)	
Seeding Chart				Modification Factors for				Modification	



<b>Seeding Chart</b>				<b>Modification Factors for Seeding Rate</b> pounds per acre (kilograms per hectare)				<b>Modification Factors for Seeding Periods</b>	
Species	Max. % Weed Seeds 7	Min. % Purity	Min. % Germination	Seeding Rate lb/ac (kg/ha)	Seeding Period A (2/16 to 4/15)	Seeding Period B (4/16 to 8/15)	Seeding Period C (8/16 to 2/15)	North District	Central and South Districts
				<b>Seeding Rate</b>  <b>pounds per acre</b>  <b>(kilograms per hectare)</b>				<b>Factors for Seeding Periods</b>	
Species	Max. % Weed Seeds 7	Min. % Purity	Min. % Germination	Seeding Rate lb/ac (kg/ha)	Seeding Period A (2/16 to 4/15)	Seeding Period B (4/16 to 8/15)	Seeding Period C (8/16 to 2/15)	North District	Central and South Districts
<b>Temporary Grass Seeding - Dry Ground</b>									
Annual Ryegrass  ( <u>Lolium multiflorum</u> )	0.15	95	90	40 (45.0)	Winter Rye  ( <u>Secale cereale</u> )  from 2/16 to 3/1		Add 65 lb/ac (73.0 kg/ha)  Winter Rye  ( <u>Secale cereale</u> )  from 10/15 to 2/15		
<b>Total Seed Quantity lb/ac (kg/ha) 40 (45.0)</b>					<b>105 (118.0)</b>		<b>105 (118.0)</b>		
<b>Temporary Grass Seeding - Wet Ground<sup>6</sup></b>									
Annual Barnyard grass/  Duck Millet  ( <u>Echinocloa spp.</u> )	1.00	90	90	40 (45.0)	Winter Rye  ( <u>Secale cereale</u> )  from 2/16 to 3/1		Add 65 lb/ac (73.0 kg/ha)  Winter Rye  ( <u>Secale cereale</u> )  from 10/15 to 2/15		
<b>Total Seed Quantity lb/ac (kg/ha) 40 (45.0)</b>					<b>105 (118.0)</b>		<b>105 (118.0)</b>		

**Seeding Chart Notes**

- 1 The seed shall be a blend of certified Bluegrass varieties with no one variety representing more than 25% by

Seeding Chart				Modification Factors for Seeding Rate pounds per acre (kilograms per hectare)				Modification Factors for Seeding Periods	
Species	Max. % Weed Seeds 7	Min. % Purity	Min. % Germination	Seeding Rate lb/ac (kg/ha)	Seeding Period A (2/16 to 4/15)	Seeding Period B (4/16 to 8/15)	Seeding Period C (8/16 to 2/15)	North District	Central and South Districts

weight of the total, at least one variety must be a Mid-Atlantic ecotype.

- 2 Combination of improved certified varieties with SR-3000 representing a minimum of 50% by weight of the total.
- 3 Germination shall include a total of 60% minimum quick germination or normal sprouts plus a minimum of 20% hard seed.
- 4 *Permanent Seeding - Wet Ground* should be used on saturated or seasonally flooded areas as dictated by defined wetland limits on the Plans.  
Festuca ovina shall be an improved variety of Sheep Fescue as approved by the Department. Selection should be based on performance within the Mid-Atlantic region as determined by the most current National Turfgrass Evaluation Program Progress Report.  
Wet, bare ground, leaf litter covered or partially vegetated retention ponds, traps, or basins, or all intermittently flooded sites in general may be seeded with *Temporary Seeding - Wet Ground*. No wood fiber mulch shall be added to the hydroseeder. In addition, no mulching item should be included with this seeding. Unless indicated on the Plans, Echinocloa spp. is equivalent to E. muricata, E. crusgalli, or E. walteri. No fertilizer or limestone shall be applied with this seeding.
- 6 No Johnsongrass seed (Sorghum halapense) or Canada Thistle (Cirsium arvense) shall be allowed under the maximum allowable percentage of weed seeds and in accordance with Section 1, Chapter 24, Title 3 of the Delaware Code.
- 7 Add 3 lb/ac (4.0 kg/ha) Weeping Lovegrass on all slopes 1:3 (vertical to horizontal) or steeper and greater than 10" (250 mm) vertically in height throughout the Central and South Districts during all seeding periods to *Permanent Grass Seeding - Dry Ground*, *Permanent Crown Vetch Seeding*, and *Permanent Grass Seeding - Wet Ground*.

**734.05 Seed Inoculant.** The inoculant for *Permanent Crown Vetch Seeding* shall be a pure culture of nitrogen fixing bacteria selected for maximum vitality and for the ability to transform nitrogen from the air into soluble nitrates and deposit them in the soil. Inoculant shall consist of purely bred cultures and shall not be used later than the date indicated on the container. Four times the normal amount of inoculant as indicated on the packaging shall be used for wet application. The inoculant shall be kept as cool as possible until used. Since temperatures above 75 to 80 °F (24 to 27 °C) weaken the bacteria, the Contractor shall take every precaution possible while handling the inoculant.

## CONSTRUCTION METHODS.

**734.06 General.** This work shall consist of preparing the ground and furnishing and placing all lime, fertilizer, and seed on the areas indicated on the Plans and as specified by the Engineer. This work shall include, in addition to the lime, fertilizer, and seed, the specified quantity of inoculant and mulch required in the seeding slurry when placing crown vetch. The Engineer reserves the right to stop seeding operations whenever conditions are determined to be unfavorable. All materials used on this Contract shall be obtained by the Contractor from a dealer or manufacturer whose product is shown by analysis to fulfill the guarantee claimed by the producers.

*Permanent Seeding - Wet Ground* and *Temporary Grass Seeding - Wet Ground*, where specified for dry application by the kilogram, shall be seeded through a hand spinner type spreader. Areas specified for this method of application shall be remote sites not otherwise accessible with wet application equipment.

### 734.07 Seeding Slopes Flatter than 1:3 (vertical to horizontal).

- a. *General.* All topsoil placement and grading where specified shall be completed before seeding. This shall apply to the following specified seeding:
  - o Permanent Grass Seeding - Dry Ground
  - o Permanent Grass Seeding - Wet Ground,
  - o Permanent Grass Seeding - Subdivisions,
  - o Temporary Grass Seeding - Dry Ground, and

- Temporary Grass Seeding - Wet Ground

- b. *Seedbed Preparation for Dry Ground Areas with Topsoil.* The area to be seeded shall be thoroughly loosened to a depth of not less than 6" (150 mm). The topsoil shall be original surface friable loam topsoil conforming to Section 732. The topsoil shall be of uniform quality, free from gravel and stones retained on a 2" (50 mm) sieve, heavy clay, frozen clods, lumps, roots, sticks, and foreign materials harmful to plant growth, such as 2" (50 mm) or larger fragments of hot-mix, concrete, and surface treatment. If shaped to the prescribed grade, the seedbed shall be considered satisfactory and shall require no further work.

However, when the area to be seeded is partially sodded, barren, weedy, or packed and hard, any grass and weeds shall first be cut or otherwise satisfactorily removed, and the soil shall then be scarified or otherwise loosened to a depth of not less than 6" (150 mm). Clods and lumps shall be broken. Rubbish, rocks, fragments 2" (50 mm) or larger of hot-mix, concrete, surface treatment, and other extraneous matter shall be removed clear of the seeding site.

No seedbed preparation will be required for *Permanent Grass Seeding - Wet Ground*, *Temporary Grass Seeding - Wet Ground*, or *Temporary Grass Seeding - Dry Ground*.

- c. *Quantities of Material.* The quantity of limestone as specified according to Subsection 734.03 (a) shall be applied at the rate of 3000 lb/ac (3400 kg/ha). Fertilizer, wood cellulose fiber, and other required seeding agents shall be applied in accordance with Subsection 734.03.

The quantity of seed applied shall be in accordance with the Seeding Chart under Subsection 734.04.

- d. *Application Equipment.* All wet application equipment shall have a tank equipped with an agitation system capable of keeping all of the solids in a state of complete suspension at all times during the seeding operation. All dry application equipment to include drop or hopper type spinner spreaders and drills shall require that all seed be blended by the seed supplier and so certified prior to dumping or loading to reduce seed segregation.
- e. *Wet Application of Lime, Fertilizer, Wood Cellulose Fiber, Seed, Inoculant, and Any Coloring or Binding Agents.* The Contractor shall apply all ingredients specified for the seeding operations described in Subsection 734.07 (a) according to both manufacturer's equipment and material specifications and as set forth according to individual seeding requirements as specified under Subsection 734.03.

*Permanent Grass Seeding - Dry Ground* shall be used in accordance with this Section on all areas not delineated or defined as wetlands that are flatter than 1:3 (vertical to horizontal) in grade and on areas behind guardrail to the top or breakpoint of slope. The only exception shall apply to slopes 1:3 (vertical to horizontal) or steeper in urban areas as described under Subsection 734.08. In these areas, topsoil shall be required at a depth of 6" (150 mm) in accordance with Sections 732 and 733 respectively.

*Permanent Grass Seeding - Wet Ground* shall be used in accordance with this Section on all areas delineated or defined as wetland on the Plans with the exception of dry fill such as stormwater pond embankments and dikes or regraded areas comprised of fill above the original wetland profile. Areas stripped under Section 202 and specified for *Permanent Grass Seeding - Wet Ground* shall be covered with 6" (150 mm) of topsoil in accordance with Section 733. Permanent dry fill areas above the original wetland profile, as described above, shall be seeded under *Permanent Grass Seeding - Dry Ground*.

In stormwater management ponds with permanent pools *Permanent Grass Seeding - Wet Ground* shall be used on the slope between the permanent pool water level and the contour line 2' (0.6 m) above the water level. In ponds without permanent pools, this seeding mix shall be applied from the pond bottom to the elevation reached during flood routing 1" (25 mm) of runoff (water quality extended detention).

*Permanent Grass Seeding - Subdivisions* shall be used in accordance with this Section on all areas defined as legal subdivisions or residential communities where maintenance is provided by the Department from curb to curb only or is limited to the traveled way and shoulders. Areas specified for *Permanent Grass Seeding - Subdivisions* shall be topsoiled with 6" (150 mm) of approved topsoil in accordance with Section 732.

*Temporary Grass Seeding - Dry Ground* shall be used in accordance with Subsection 734.03 on all areas that represent dry ground areas disturbed during actual construction and/or prior to the establishment of permanent grades as determined by the Engineer in the field.

*Temporary Grass Seeding - Wet Ground* shall be used on wet, bare ground, leaf litter covered or partially vegetated retention ponds, traps, basins, and all intermittently flooded areas during construction.

- f. *Dry Application of Lime, Fertilizer, and Seed.* Only the ingredients described shall be applied by dry application. All lime, fertilizer, and seed shall be applied each as a separate operation when using dry methods of application. Dry application of lime, fertilizer, and seed shall apply to all forms of seeding described under Subsection 734.07 (e).
- g. *Responsibility for Seeded Areas.* The Contractor shall perform all seeding and mulching in accordance with this Section in the presence of the Engineer. If all work as noted is performed in complete accordance with this Section to the satisfaction of the Engineer, all seeding and mulching so approved shall be accepted.

The Department retains the right to request that the Contractor reseed any and all areas where a satisfactory stand of grass or crown vetch or both as determined by the Engineer does not exist at the time of the final inspection.

If the Engineer determines that reseeding is necessary, the Contractor shall begin reseeding within five working days of an oral or written request from the Engineer.

#### **734.08 Seeding Slopes 1:3 (vertical to horizontal) or Steeper.**

- a. *General.* For slopes 1:3 (vertical to horizontal) or steeper, the following specified seeding shall be used:
  - Permanent Crown Vetch Seeding,
  - Permanent Grass Seeding - Dry Ground, and
  - Temporary Grass Seeding - Dry Ground
- b. *Seedbed Preparation.* All slopes shall be tilled and scarified across the slope, or tracked to prevent gully and sheet erosion to the satisfaction of the Engineer.
- c. *Quantities of Material.* The quantity of limestone as specified according to Subsection 734.03 (a) shall be applied at the rate of 3000 lb/ac (3400 kg/ha) for all seeding except *Permanent Crown Vetch Seeding* which shall be applied at a rate of 55 lb/ac (60 kg/ha). Fertilizer, wood cellulose fiber, and other required seeding agents shall be applied in accordance with Subsection 734.03. Refertilization and liming when specified for use shall be applied in accordance with Subsection 734.03 (a) and (b)(1).

The quantity of seed applied shall be in accordance with the Seeding Chart under Subsection 734.04.

- d. *Application Equipment.* All wet application equipment shall have a tank equipped with an agitation system capable of keeping all of the solids in a state of complete suspension at all times during the seeding operation. All dry application equipment to include drop or hopper type spinner spreaders and drills shall require that all seed be blended by the seed supplier and so certified prior to dumping or loading to reduce seed segregation.
- e. *Wet Application of Lime, Fertilizer, Wood Cellulose Fiber, Seed, Inoculant, and Any Coloring or Bindings Agents.* The Contractor shall apply all ingredients specified for the seeding operations described in Subsection 734.08 (a) according to both manufacturer's equipment and materials specifications and as set forth according to individual seeding requirements as specified under Subsection 734.03.

*Permanent Crown Vetch Seeding* shall be used in accordance with this Section on all slopes 1:3 (vertical to horizontal) or steeper such as fill embankments or berms that are not mowable. Areas specified for crown vetch shall not be topsoiled. Landlocked or isolated small areas such as guardrail end terminal slopes shall be seeded with crown vetch rather than other normally specified seeding to facilitate maintenance.

The only exception shall apply to slopes 1:3 (vertical to horizontal) or steeper in urban areas, where at the designer's discretion, *Permanent Grass Seeding - Dry Ground* may be selected in lieu of *Permanent Crown Vetch Seeding*. In these areas, topsoil shall be placed at a depth of 6" (150 mm) in accordance with Section 732 or 733 respectively.

- f. *Dry Application of Lime, Fertilizer, and Seed.* Only the ingredients described shall be applied by dry application. All lime, fertilizer, and grass seed shall be applied each as a separate operation when using dry methods of application. Dry application of lime, fertilizer, and grass seed shall apply to all forms of seeding

described under Subsection 734.07 (e).

All lime, fertilizer and crown vetch seed shall be applied each as a separate operation when using dry methods of application. Inoculant shall be pre-mixed with the crown vetch seed at triple the normal rate of inoculant in the presence of the Project inspector. The inoculant and crown vetch seed must be mixed with an approved wetting or bonding agent.

- g. *Responsibility for Seeded Areas.* The responsibilities for seeded areas shall conform to the requirements of Subsection 734.07 (g).

**734.09 Method of Measurement.** The quantity of refertilization and the type of seeding will be measured in square yards (square meters) of surface area.

Exceptions to this are *Permanent Grass Seeding - Wet Ground* and *Temporary Grass Seeding - Wet Ground* when specified for dry application. For these exceptions, the quantity will be measured in total number of pounds (kilograms) of grass seed.

Where units are expressed in total square yards (square meters), the quantity will be measured along the ground surface of seeded areas.

**734.10 Basis of Payment.** The quantity of refertilization and the type of seeding will be paid for at the Contract unit price per square yard (square meter). Price and payment will constitute full compensation for preparing the ground; for furnishing and placing all materials; and for all labor, equipment, tools, and incidentals required to complete the work. Exceptions to this are *Permanent Grass Seeding - Wet Ground* and *Temporary Grass Seeding - Wet Ground* when bid by the pound (kilogram). For these exceptions, price and payment will constitute full compensation for furnishing and placing all materials and for all labor, equipment, tools, and incidentals required to complete the work. Payment for any and all reseeding of areas, where a satisfactory stand of grass or crown vetch, or both, as determined by the Engineer does not exist at the time of final inspection, will be made at the Contract unit price for seeding and mulching. If the Contractor fails to respond within five working days of the Engineer's oral or written request, no payment for such reseeding will be made.

## **SECTION 735 MULCHING**

**735.01 Description.** This work consists of furnishing, placing, and anchoring mulch over seeded areas.

### **735.02 Materials.**

*Small Grain Straw.* Straw for mulching shall be from oats, wheat, rye, or other approved grain crops that are free from noxious weeds, mold, or other objectionable material. Straw mulch shall be in an air-dry condition and shall be suitable for placing with an approved mechanical blower.

### **735.03 Construction Methods.**

*Small Grain Straw.* Straw mulching shall be used on all slopes flatter than 1:3 (vertical to horizontal) with the exception of slopes or sites not accessible to tracking or crimping tools and equipment. In these situations, straw-coconut fiber blankets or bonded fiber matrix shall be used.

Small grain straw shall be uniformly and evenly applied immediately after seeding has been completed. An approved mechanical blower shall be used to apply the straw. Straw mulch applied by blowers shall provide a loose depth of not less than 1/2 nor more than 2" (13 nor more than 50 mm). Ninety-five percent of the blown and shredded straw mulch shall be 6" (150 mm) or more in length when in place.

Straw mulch shall be applied at the rate of 4000 lb/ac (4500 kg/ha) and secured by one of the following methods:

1. *Crimping Method.* This method of incorporating the straw into the ground shall be accomplished with the use of crimping device that produces horizontally oriented indentation. Straw mulch shall be incorporated into the soil to a minimum depth of 2" (50 mm). The crimping device shall be approved by the Engineer.
2. *Tracking Method.* This method may be used on all sites mulched with straw and shall involve the use of steel-cleat track-type equipment driving up and down the slopes producing horizontally oriented indentations with the cleats. Cleats shall be capable of incorporating the straw mulch into the soil to a minimum depth of 12" (40 mm). The equipment used and the method of tracking shall be approved by the Engineer.

**735.04 Method of Measurement.** The quantity of mulching will be measured in square yards (square meters) of actual surface mulched along the surface of the treated area.

**735.05 Basis of Payment.** The quantity of mulching will be paid for at the Contract unit price per square yard (square meter). Price and payment will constitute full compensation for furnishing and placing all materials; for all methods of securement; and for all labor, equipment, tools, and incidentals required to complete the work.

## **SECTION 736 SODDING**

**736.01 Description.** This work consists of preparing the ground area, and furnishing and placing approved sod.

### **MATERIALS.**

**736.02 Sod.** Sod shall be well rooted from high quality seed of known origin and native to the locality of the work. The Department reserves the right to visit the proposed sod source prior to the granting of a source approval. Sod shall be stripped, delivered, and laid within a period of 36 hours. Sod stripped and delivered but not laid within this period shall be re-inspected and approved by the Engineer prior to use.

Creeping Red Fescue	(Festuca rubra L. subsp. Rubra)	10%
Chewing Fescue	(Festuca rubra L. subsp. commutata Gavd.)	20%
Hard Fescue	(Festuca longifolia Thuill.)	55%
Kentucky Bluegrass	(Poa pratensis L.)	15%

If Fine Fescue-Bluegrass sod is used, it shall contain the following percentages by weight in the blend:  
The varietal makeup of the Fine Fescue-Bluegrass sod must be submitted to the Engineer for approval prior to the actual cutting and lifting of the sod.

Sod shall be free of objectionable grassy and broadleaf weeds. Sod shall be considered free of such weeds if less than five such plants are found per 100 ft<sup>2</sup> (10 m<sup>2</sup>) of area. Sod shall not be acceptable if it contains any of the following weeds: common bermudagrass (wiregrass), quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canadian thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, or brome grass.

Sod shall be reasonably free of thatch, diseases, nematodes, and soil-borne insects. All sod must display the official State Certification tags of the state from which the sod originated. The same shall apply to all sod shipped intra-state with prior inspection and tagging through the Delaware State Department of Agriculture.

**736.03 Water.** Water shall conform to the requirements of Section 803.

### **CONSTRUCTION METHODS.**

**736.04 Cutting Sod.** Before stripping, sod shall be mowed uniformly at a height of 1 to 22" (25 to 65 mm). Sod shall be machine cut at a uniform soil thickness of 5/8 " 3" (16 " 6 mm), at the time of cutting. Measurement for thickness shall exclude top growth and thatch. The sod pad size shall be cut to a minimum uniform width of 12" (300 mm) and a minimum length of 12" (300 mm).

**736.05 Placing.** Sod shall be placed only when the soil is moist and favorable to growth. Sod shall not be placed between November 1 and April 1, unless weather and soil conditions are considered favorable and permission is granted.

**736.06 Preparation of Grade.** The area to be sodded shall be shaped and finished to the lines and grades indicated on the Plans, and the surface loosened prior to placing the sod. The Contractor shall water the slope before the sod is placed.

**736.07 Laying the Sod.** The sod shall be placed on the prepared surface with the edges in close contact. Each strip or section of sod shall be fitted and tamped into place with hand tampers of not less than 100 in<sup>5</sup> (64 000 mm<sup>5</sup>) in area. After slopes of either cuts or fills have been shaped to conform to the finished grade and cross-section shown on the Plans, the shoulders and toes of the slope shall be rounded off to a 5' (1.5 m) radius, or as otherwise indicated in the Plans.

On all slopes, sod shall be laid with the long edges parallel to the contour starting at the bottom of the slope. Successive strips shall be neatly matched, and all joints staggered or broken. When placing sod in drainage ditches, the length of the strip shall be laid parallel to the direction of the flow of the water. Where the sod may be displaced during sodding operations, the workers, when replacing it, shall work from ladders or treated planks to prevent further displacement.

Each strip or section of sod placed on slopes 1:2 (vertical to horizontal) and steeper, and surface drainage V-shaped or flat bottom ditches or gutters, shall be staked securely with at least two stakes or pins spaced not more than 24" (600 mm) apart with the flat side against the slope. Stakes shall either be wood wedges or T-shaped wire pins. Wood wedges shall be 2 by 1 by 6" (13 by 25 by 150 mm) to 2 by 1 by 12" (13 by 25 by 300 mm), as required by soil conditions, and driven so that the last 1" (25 mm) remains above the top of the sod. T-shaped wire pins shall be machine bent from 15" (380 mm) pieces of 8 gage (4.1 mm) low carbon bright steel with a 8" (200 mm) leg, a 4" (100 mm) head, and a 1" (25 mm) secondary drive and driven flush with the top of the sod.

When sodding adjacent to a sidewalk, curb, pavement, or retaining walls, sufficient allowance shall be made in grading for the thickness of the sod, so that when placed, the sod shall be flush with the tops of such structures. The sod shall be tamped to ensure tight joints and a smooth level surface. As the top of the slope is reached, the sod shall be trimmed to a line placed at a fixed distance from the break of the bank and along the entire length of the cut or fill. The top of the bank shall have been previously graded, so that the sod, when applied, comes flush with the average level of the top of the bank. All surfaces shall be uniform in appearance and reasonably true to line and grade. The Contractor shall water the sod immediately after placement to a depth sufficient so that the underside of the new sod pads and soil immediately below the sod are thoroughly wet. The sod shall be kept moist until growth is established. All sod in which shrinking, burning, or turning brown occurs shall be rejected, removed, and replaced. A satisfactory stand of grass from sod, as determined by the Engineer, shall be required. To be acceptable, a stand of grass from sod must display an even flush of growth and show evidence of soil surface contact, minimal undermining, and minimal erosion.

**736.08 Method of Measurement.** The quantity of sodding will be measured in square yards (square meters) along the surface of the area of sod placed and accepted.

**736.09 Basis of Payment.** The quantity of sodding will be paid for at the Contract unit price per square yard (square meter). Price and payment will constitute full compensation for furnishing all materials, including sod; for grading, rounding the shoulders and toes of slopes, hauling, laying, and tamping; for all watering until final acceptance; and for all labor, equipment, tools, and incidentals required to complete the work.

## **SECTION 737 PLANTING**

**737.01 Description.** This work consists of furnishing and planting specified plants, shrubs, and trees and the replacement and cultural care of the material.

### **MATERIALS.**

#### **737.02 Plant Material.**

- a. *Quality.* All plants shall be true to type and nomenclature and typical of their species or variety. They shall have a normal habit of growth with well-developed branch systems and vigorous root systems. They shall be sound, healthy, and vigorous plants, free from defects, disfiguration, injury, disease of any kind, insect eggs, borers, and any infestation. All plants shall be nursery grown. They shall have been growing under similar climatic conditions to those of the locality of the Project for at least two years prior to planting. All plant material shall have been grown in a soil that is similar to this area and shall not have been grown in a muck type soil or other foreign type. It shall be the responsibility of the Contractor to inspect the plants before removal from the nursery where they have been grown to make sure that the plants meet these requirements. All plants shall be freshly dug, and no heeled-in or cold storage plants will be accepted, with the exception of plant material delivered prior to planting as outlined in Subsection 737.14.
- b. *Measurements.* All plants shall conform to all sizes and measurements specified in the Plant List. Plants that conform to the requirements specified in the Plant List but do not have a normal balance between height and spread will not be accepted. Where any requirement or exact measurement is omitted, the plants furnished shall be normal for the species and variety as listed in AAN's "USA Standards for Nursery Stock". Plants for use where symmetry is required shall be matched as close as possible. All plants shall be measured for height and spread with the branches in their normal position. The diameter of all trees shall be taken 6" (150 mm) above

the ground level for up to and including 4" (100 mm) diameter sizes, and 12" (300 mm) above the ground level for larger sizes. The height of the branches on the tree trunks need not be as specified if the required height can be obtained by pruning the lower branches without leaving unsightly scars and damaging the trunk. No pruning of branches for this effect shall be done before delivery to the site unless approved.

Plants larger in size than specified may be used. Larger plants, when selected for use over that which is specified, shall be dug with an earth ball or root spread proportionate to the increased size.

With plants smaller than specified, credit shall be offered to the Department for approval. The basis of a credit shall be the average wholesale value based on the difference between the specified size and the next smaller size. The average wholesale value shall be substantiated with written submissions in accordance with Subsection 737.02 (e).

- c. *Inspection.* The Contractor shall be responsible for all certificates of inspection of plant materials that may be required by Federal, State, or other authorities to accompany shipment of plants.

The Contractor shall furnish complete information as to the location of all plants which it intends to supply and use. The right is reserved to inspect, tag, and approve all plants at the source of supply. This inspection and tagging shall not in any way eliminate the right of rejection at the site. All plants must be inspected and approved before they are planted. Any plants placed without prior inspection at the site will be rejected at the discretion of the Engineer.

The Contractor shall furnish a complete listing of the locations and the quantities of each species at each location for all plant species it intends to use on the Project. Plant materials shall be protected according to best horticultural practice while in transit in such a way as to prevent the drying or possible desiccation of plant tissue. All plant material arriving at the site with broken or loose balls, or dry or insufficiently developed roots, and plants which are weak or thin, damaged or defective, or which do not comply with the specifications, will not be accepted. The Engineer reserves the right to reject all stock that is found to be unsatisfactory. All plant material determined as unsatisfactory by the Engineer shall not be planted under any circumstances and shall be removed from the Project site by the close of the working day. Failure on the part of the Contractor to comply with any of the above procedures will require an immediate suspension of all work.

- d. *Nomenclature.* Plants shall conform to the nomenclature of "Standard Plant Names" as accepted by the American Joint Commission of Horticulture Nomenclature, 1942 Edition. Names of varieties not included shall conform to names accepted in nursery trade. Size and grading shall conform to those listed in AAN's "USA Standards for Nursery Stock". No substitution will be permitted except by written permission of the Engineer.
- e. *Availability.* The Engineer, after receiving written request from the Contractor for substitution, will verify and establish the non-availability of the specified plant and size to this satisfaction. Upon determining that a substitution is justified, the Contractor will be directed to provide certification in the form of five letters from five independent growers who list the specified plant form in their most current catalog, stating that the item in question is not available as specified.
- f. *Experience.* Under Special Condition No. 22 of the U.S. Army Corps of Engineers 404 Permit, it is stipulated that:

*The mitigation and post-planting monitoring plans shall be developed and implemented by a firm with demonstrated expertise in wetland creation activities.*

Therefore, the firm that does the actual planting and seeding of the mitigation site shall possess a record of successful wetland woody and wetland herbaceous and seeding programs that have received final approval by the U.S. Army Corps of Engineers, or have on-site staff personnel who have managed successful wetland woody and herbaceous planting and seeding programs that have received final approval by the U.S. Army Corps of Engineers. At the request of the Department, information indicating compliance with this "Special Condition" shall be forwarded within 14 days.

**737.03 Trees.** Trees shall have straight trunks according to their habit of growth and shall be well branched and rooted. Shade trees of standard variety shall have a single leader and shall be branched at 6 to 8' (1.8 to 2.4 m) height unless otherwise directed.



**737.04 Shrubs.** Shrubs shall be well branched, with full and compact growth and have ample well branched root systems capable of sustaining vigorous plant growth. There are two categorizes of wetland shrubs:

- a. *Wetland Grown Containerized Shrubs.* All shrubs shall be wet grown plants. These plants shall been grown in permanently saturated soils for a minimum of one full growing season prior to the planting of the material. The stock shall not be grown in soilless mixes. The nursery providing these materials shall certify in writing that these plants have been grown in permanently saturated soils for a minimum of one full growing season.

All container shrubs shall be healthy, vigorous, well rooted, and established in the container in which they are grown. They shall have tops of good quality and in a healthy growing condition. There shall be a minimum of two healthy vigorous canes per shrub. The container grown stock shall have been grown in the container long enough to allow for new fibrous roots to have developed so that the root mass retains its shape and holds together when removed from the container.

- b. *Wetland Shrub Cuttings.* Cuttings shall be fresh 24" (600 mm) long stems of woody plants. Each cutting shall have a living terminal bud (end bud). Prior to installation, the cutting shall be kept cool and moist to prevent desiccation of the material. Degraded, rotting, or dried out material will not be accepted.

**737.05 Ground Cover, Herbaceous Perennial, and Wildflowers.** Ground cover shall be one year old, container grown plants, unless otherwise approved or specified in the Contract documents and shall have been growing for at least six months in the size specified as verified by the Department's inspection representative.

Herbaceous perennial shall be six months old, container grown plants and shall have been growing for at least three months in the size specified as verified by the Department's inspection representative.

Wildflowers shall be native annual, biennial, or perennial forms at least three months old, container grown plants and shall have been growing for at least one and a half months in the size specified as verified by the Department's inspection representative.

**737.06 Topsoil.** Planting topsoil shall consist of natural surface soil from well drained areas from which no topsoil has previously been stripped. The topsoil shall be free of subsoil, heavy clay, hard clods, weeds, roots, sticks, toxic substances, or any other extraneous material. The topsoil shall have a pH range of from 5.5 to 6.8 and contain not less than 2% nor more than 10% organic matter. The topsoil shall exhibit the following grading analysis:

<i>Sieve Size</i>	<i>Minimum Percent Passing</i>
2" (50 mm)	100
No. 4 (4.75 mm)	90
No. 10 (2.00 mm)	80

The Contractor shall take the necessary action to ensure that the topsoil meets the sieve analysis, acidity, and organic matter requirements. A certificate of analysis of soil samples shall be provided to the Engineer and approved prior to delivery of topsoil to the Project site.

**737.07 Peat Moss and Peat Humus.**

- a. *Peat Moss.* Peat moss shall be from sphagnum peat bogs. All peat moss shall be shredded, not dusty, and free of twigs, stones, hard lumps, roots, or any other undesirable materials. All peat moss must be moistened before using, but not watered to a saturated or puddled, unworkable condition. Peat moss shall show an acid reaction of 3.5 to 5.5 pH. The Contractor shall provide written certification from the manufacturer that the peat moss was obtained from sphagnum peat bogs.
- b. *Peat Humus.* Peat humus shall be a natural peat or peat humus from fresh water saturated areas, consisting of sedge, sphagnum, or reed peat and be of such physical condition that it passes through a 2" (12.5 mm) sieve. The humus shall be free from sticks, stones, roots, and other objectionable materials. Samples taken at the source of supply shall have the following analysis:

Acidity Range	4.0 to 7.5 pH
Minimum Water Absorbing Ability	200% by weight on oven-dry basis
Minimum Organic Content	60% when dried at 221 EF (105 EC)

**737.07 Fertilizer.** Fertilizer shall be a 20-10-5 analysis or approved equal in accordance with the following minimum guaranteed analysis:

Total Nitrogen (N)	20.00%
Derived from urea-formaldehyde	
7.0% water soluble nitrogen	
13.0% water insoluble nitrogen	
Available Phosphoric Acid (P <sub>2</sub> O <sub>5</sub> )	10.00%
Derived from calcium phosphate	
Soluble Potash (K <sub>2</sub> O)	5.00%
Derived from potassium sulfate	
Combined Calcium (Ca)	2.60%
Derived from calcium phosphate	
Combined Sulfur (S)	1.60%
Derived from ferrous and potassium sulfates	
Iron (expressed as elemental Fe)	0.35%
Derived from ferrous sulfate	

The fertilizer shall be formulated in tablet form weighing a minimum of 20 g per tablet.

The fertilizer shall conform to all State and Federal regulations. The Engineer will require the Contractor to furnish an affidavit from the vendor or a testing laboratory as to the available nutrients contained therein.

Fertilizer shall be furnished in new, clean, sealed, and properly labeled packages or containers. Fertilizer failing to meet the specified analysis may be used as determined by the Engineer, providing sufficient materials are applied to comply with the specified nutrients per unit of measure.

**737.09 Mulch.** Mulch shall be either chopped pine bark, licorice root, shredded hardwood bark, wood chips, tan bark, or an approved equal as accepted by the Engineer. All mulching materials will be visually inspected by the Engineer prior to delivery at the planting site and shall conform to the following requirements:

- a. Chopped pine bark shall be freshly prepared so as not to be decomposed or in any condition that may shorten its lifetime as an effective mulch. It shall be free of stones, sticks, weed seeds, pieces of wood, or bark that measure 4" (100 mm) in their longest dimension and shall not contain any toxic or foreign materials. The mulch shall contain no more than 50% of material passing through a 3/4" (19.0 mm) sieve.
- b. Licorice root shall be the by-product of the licorice extraction process. It shall be fibrous material free from all foreign and toxic substances.
- c. Tan bark shall be a by-product of the tanning process. It shall be fibrous and free of foreign and toxic substances.
- d. Shredded hardwood bark shall be from a deciduous hardwood source and be mechanically ground to a maximum size of 6" (150 mm). In addition, the bark shall be relatively free of bark fines dust and shall exclude all foreign and toxic substances.
- e. Wood chips must be stockpiled for at least one year prior to placement as verified by the Department's inspection representative and shall not contain leaves, twigs, wood shavings and sawdust, or any foreign or toxic substances. In addition, fertilizer in accordance with Subsection 737.08 shall be applied at the rate of 0.5 lb/yd<sup>5</sup> (0.25 kg/m<sup>2</sup>) prior to wood chip placement.

Only one of the above mulches will be selected and approved for use throughout the entire Project, and written certification for the above listed requirements of the mulch shall be submitted by the Contractor.

### 737.10 Stakes, Guys, and Related Materials.

- a. *Guy Wire or Cable.* Guy wire shall be annealed galvanized wire, free of bends or kinks, with a diameter of 14 or 12 gage (2.0 or 2.7 mm). Guy cable shall be 3" (6 mm) seven-strand wire rope.
- b. *Turnbuckles.* Turnbuckles shall be galvanized with 42" (108 mm) openings and 5/16" (8 mm) threaded ends with screw eyes. Zinc coating when tested shall conform to the requirements of AASHTO M 232/M 232M specifications for galvanization.
- c. *Tree Stakes.* Tree stakes shall be hardwood stakes at least 2 by 2" (50 by 50 mm) rough sawed to the length required. The lower half of each stake shall be given a flow coat of 5% pentachlorophenol solution or otherwise treated with an approved material and method. The Contractor shall submit the manufacturer's written certification for any stake treatment and accomplish such work in the presence of the Engineer.
- d. *Rubber Hose.* Rubber hoses shall be new, two-ply rubber (reinforced) hose with an outside diameter of at least 5/8" (16 mm).
- e. *Wrapping Materials.* Wrapping material shall be clean, new burlap, 7 to 8 oz/yd<sup>2</sup> (240 to 270 g/m<sup>2</sup>), in strips 4 to 6" (100 to 150 mm) wide, or horticultural approved waterproof wrapping paper 30-30-30 ratings in 4" (100 mm) strips. The Contractor shall provide in writing the manufacturer's certification for the above-mentioned wrapping material requirements.
- f. *Twine.* The tying material used to secure the tree wrap shall be at least two-ply jute twine.
- g. *Anchors.* Anchors for guy wire shall be malleable iron or aluminum alloy with 3000 lb (13 kN) holding capacity designed to be inserted with a driving rod to a depth specified by the manufacturer. The anchor assembly shall be designed to turn, once located at the proper depth, at a right angle to the line of force applied. All manufacturer's recommendations shall be followed for installing ground anchors.
- h. *Tree Wound Dressing.* Dressing for treating tree wounds or cuts shall be either:
  1. an approved black paint asphaltum base antiseptic paint;
  2. an approved black paint consisting of Bordeaux Mixture, raw linseed oil, and lamp black; or
  3. an approved black paint consisting of zinc oxide, raw linseed oil, and lamp black.

**737.11 Water.** All water for watering plants shall conform to the requirements of Section 803.

### CONSTRUCTION METHODS.

**737.12 Planting Periods.** All plant material shall be planted during the following planting period with the exceptions as noted:

*Balled or Burlapped and Potted or Container Grown Plant Material:*

*March 1 to December 1:*

- (1) All planting of broadleaf evergreens during the fall season shall be completed by November 1.
- (2) All bare root material shall be planted between October 15 and May 15.
- (3) All material planted from May 30 to August 30 must be treated with an approved antitranspirant in a manner recommended by the manufacturer, and written approval for moving plants within this period must first be obtained from the Engineer.
- (4) Wetland shrubs and cuttings shall be installed as dormant materials between October 30 and December 1 or between March 1 and May 1.

The above mentioned period may be extended or reduced according to weather and soil conditions at the time and at the discretion of the Engineer. The Engineer reserves the right to stop planting operations at any time.

The Contractor shall not plant when weather conditions are unfavorable for proper work or when the soil is in a frozen condition.

**737.13 Soil Mixture.** Soil mixtures for the various plantings shall consist of the following:

- a. *All Plants Except Epricaceous Material.* For each cubic yard (cubic meter) of baled peat moss, or approved equal, add from 43 to 54 yd; (43 to 54 m<sup>3</sup>) of planting topsoil.
- b. *Epricaceous Plants.* For each cubic yard (cubic meter) of baled peat moss, or approved equal, add from 36 to 45 yd; (36 to 45 m<sup>3</sup>) of planting topsoil.

If peat humus is furnished in lieu of peat moss in the above mix, the mixture shall be based in the proportion of 1.8 yd; (1.8 m<sup>3</sup>) of peat humus for each cubic yard (cubic meter) bale of peat moss specified for the above soil mix. Other approved equal materials shall be mixed according to manufacturer's printed recommendations which shall be submitted to the Engineer

for written approval.

The above soil mixtures shall be mixed as specified in an area approved by the Engineer. No mix shall be prepared prior to notification of the Engineer at least 48 hours in advance of the mixing operation. Where ground covers or herbaceous perennials are specified, the soil mix may be mixed in place providing the existing topsoil conforms to the requirements of Section 732.

The fertilizer as specified in accordance with Subsection 737.08 shall be placed according to the following requirements:

- a. *Bare Root, Balled or Burlapped, or Container Stock.* Position the plant in the hole, and backfill no higher than halfway up the root ball. Place the recommended number of tablets evenly around the perimeter of and immediately adjacent to the root ball. Complete the backfilling, tamping, and watering.
- b. *Small Ground Cover Plants and Herbaceous Perennials.* Position the plant in the hole, and backfill no higher than halfway up the root ball. Place the recommended number of tablets evenly around the perimeter of and immediately adjacent to the root ball. Complete the backfilling, tamping, and watering.
- c. *Trees.* Use one 20 g tablet for each 2" (13 mm) of tree trunk diameter based on size specified for planting.
- d. *Shrubs.* Use one 20 g tablet for each 12" (300 mm) of height or spread based on size specified for planting.
- e. *Ground Cover and Herbaceous Perennials.* Use one 20 g tablet for each plant.

No backfill shall be placed in any pit until the excavation has been inspected. Excess excavated material shall be removed from the Project site. The single exception to the above guidelines relates to wetland shrubs. In the wetland shrub areas, topsoil or muck shall be placed prior to the planting. At the discretion of the Engineer, this topsoil or muck shall serve as the soil mixture for the wetland shrubs.

**737.14 Digging and Handling.** All precautions customary in good trade practice shall be taken in preparing plants for transplanting. Plants transplanted with workmanship that fails to meet the highest standards will be rejected. All plants shall have firm, natural balls of earth of ample proportions and diameter not less than as specified in AAN's "USA Standards for Nursery Stock". Plants with cracked, broken, or crushed balls, which occur either before or during planting operations, will be rejected and shall be removed from the site immediately. Bare root plants shall be dug with sufficient spread and depth of roots as to ensure full and prompt recovery and development of the plants. Bruises and injury to roots shall be avoided. All plants shall be handled so that roots are adequately protected and moist at all times. Material that cannot be planted immediately after delivery shall be adequately protected by covering with canvas, wet straw, burlap, moss, or other suitable material and kept covered until ready to be planted. Trees should not be planted with frozen earth balls.

**737.15 Location of Plants.** Plants shall be located as indicated on the Plans, but may be shifted to avoid utilities subject to the approval of the Engineer. In all mass planting areas, the plants shall be evenly spaced to give uniform cover in the planting bed area. No excavation shall commence until locations are approved.

**737.16 Planting.** All trees and shrubs shall be planted in pits as detailed on the Standard Construction Details. Pits shall be excavated with vertical sides. Pits shall be of such a depth that, when planted and settled, the crown of the plant shall bear the same relation to finished grade as it did to soil surface in its place of growth. With the approval of the Engineer, the Contractor may elect to plant wetland grown containerized shrubs on small mounds raised no more than 2" (50 mm) above the final grading elevation shown on the Plans.

Open plant pits shall not be allowed overnight in residential areas or in any location where it is determined by the Engineer to pose a potential hazard to pedestrians or traffic.

All backfill topsoil shall be covered with a waterproof material after mixing. Pits shall be backfilled with specified soil mix and compacted firmly, especially under ball of roots to establish a firm foundation. Plants shall be set in the center of pits in a vertical position so that the crown of the plant is level with the finished grade after allowing for watering and settling of soil. The "Soil Mixture" shall be carefully and firmly worked and tamped under and around the base of the ball to fill all voids. When partially backfilled and compacted, the burlap shall be removed from the sides and tops of the balls and cut away to prevent air pockets, but no burlap shall be pulled from under the balls. A ring of earth shall be

formed around the plant to produce a dish for watering. All plants shall be thoroughly watered immediately after planting as directed by the Engineer. This shall mean complete saturation of all backfill in the pits and beds during the same day of planting. Care shall be taken during all planting operations to ensure that no excavated material is dumped on any grassed area unless a suitable type of matting or protective underlay is used. The Contractor shall be responsible for all damage to any grassed, planted, or other landscaped area caused by its operations and shall repair any damage so caused in a manner satisfactory to the Engineer.

For wetland shrub cuttings, immediately prior to installation, the basal 12" (300 mm) segment of the 24" (600 mm) long wood cutting shall be moistened and treated with a standard horticulture rooting compound for woody stock. The cutting shall then be inserted into the ground to a depth of 12" (300 mm), terminal bud end up. To ensure good cutting/soil contact and to eliminate air pockets, firm foot pressure shall be applied immediately adjacent to the cutting. This material shall be mulched in accordance with (c) below with a mulching radius of 12" (300 mm).

Ground cover and herbaceous perennial areas shall be prepared by rototilling to a minimum depth of 10" (250 mm). The mixing of peat moss, peat humus, or approved equal may be performed separately in order to obtain the proportion of ground cover or herbaceous perennial soil mixture as specified.

Beyond the minimum excavation as stated above for soil mixing, the root system of the plant shall determine the actual depth for individual plant excavation. Plants shall be backfilled with the soil mixture and compact firmly around roots. All areas shall have a smooth and uniform grade and a minimum of 2" (50 mm) of approved mulch.

- a. *Pruning.* All plants shall be pruned immediately after planting or transplanting to remove all injured or dead wood. All trees inspected and tagged at the nursery shall conform to AAN Standards, and any subsequent pruning by the Contractor shall in no way alter the natural habit or shape of the plant. All pruning shall be done with sharp tools by workers skilled in this operation. All cuts shall be made flush, leaving no stubs. On all cuts over 3/4" (19 mm) in diameter and bruises or scars on the bark, the injured cambium shall be traced back to living tissue and removed; wounds shall be smoothed and shaped so as to preserve the branch bark ridge.
- b. *Watering.* Plants shall be watered as required to maintain them in a live and healthy condition.
- c. *Mulching.* Trees and shrubs shall be mulched with at least a 4" (100 mm) cover of mulch. Mulch shall be placed the same day of planting, unless otherwise approved by the Engineer.
- d. *Wrapping.* All trees shall be wrapped with the wrapping material overlapping 12" (38 mm), wound from the lowest main branches to the base of the tree as illustrated on the Plans. The wrapping shall be tied at the top and bottom and at 12" (300 mm) intervals along the trunk with twi
- e. *Staking and Guying.* Unless approved by the Engineer, all staking and guying specified shall be completed the same day as planting and mulching.
- f. *Cleaning Up.* Throughout the course of planting, excess and waste materials shall be immediately removed from the site, seeded areas kept clean, and all precautions taken to avoid damage to existing structures, trees, shrubs, plants, and grass. When planting in an area that has been otherwise completed, the area shall, upon completion of the planting, be immediately and thoroughly cleared of all debris, rubbish, subsoil, and all waste materials removed from the site. All ground surfaces shall be raked smooth. All sodded areas disturbed as a result of construction shall be repaired by the Contractor.

**737.17 Plant Establishment.** The plant establishment period for all planting shall begin immediately after all planting and replacements, as specified under Subsection 737.16, are complete and acceptable to the Engineer. The plant establishment period consists of one full growing season during which time the Contractor shall be responsible for all work necessary to keep the plants in a live and healthy condition. If the Contractor completes all planting or transplanting, as specified under Subsection 737.16, by May 1, the semi-final inspection will be held on or about October 1 of that year. In the event the Contractor does not complete all planting and transplanting by May 1, the semi-final inspection will be held on or about October 1 of the following year. All replacement plant material determined to be necessary at the semi-final inspection must then be approved at the replacement plant source by October 15. At this time, the Engineer will direct the Contractor to replace those plants determined to be dead or unhealthy by December 1. The Contractor shall notify the Engineer in writing that all replacement planting has been accomplished. The Engineer will conduct a final inspection within 15 days after such notification to determine the acceptability of the replacements. If all replacements are at this time determined satisfactory by the Engineer, the Contractor will be relieved of all further responsibility for care and replacement.

The plant establishment and acceptance requirements for wetland grown containerized shrubs and wetland shrub cuttings are as follows:

- a. *Wetland Grown Containerized Shrubs.* Acceptance of this stock shall be in full compliance with Subsection 737.04, except for those portions that deal with weed and grass invasion and damage that results from fire,

theft, vehicular damage, or acts of vandalism. For a three-year period following the initial planting, the Engineer may request new plantings, and the Contractor shall furnish such plantings at the original bid price plus inflation. The inflation factor will be determined by the Department.

- b. *Wetland Shrub Cuttings*. The installation of cuttings is an experimental procedure requested by the interagency task force that designed the mitigation. There shall be no guarantees or plant establishment periods associated with this installation.

All planting areas shall be kept free of weeds and grass during the life of the Contract. The Contractor may use a pre- or post-emergent herbicide to control such grass and weeds and shall be totally responsible for the proper use and placement of any such herbicide. As requested in writing by the Engineer, the Contractor shall be responsible to weed within all plant beds and within the saucer limits of individual plants, beginning ten calendar days after the date of notification. The Contractor shall prune and apply insecticides or fungicides as required, repair or replace stakes and guy wires, tighten guy cable or wire, and repair plant saucer washouts when and as specified by the Engineer. Any plants that settle below or rise above the desired finished grades shall be reset at the proper grades. All replacements shall be plants of the same kind, size, and quality as originally specified in the Contract, and they shall be furnished, planted, mulched, guyed, and watered as specified herein for new plant material.

If dead or unhealthy plants are discovered, they shall be removed and replaced within ten calendar days after the date of written notification.

If, upon written request, the Contractor fails to proceed within seven calendar days with the above requirements, the Engineer may arrange for and proceed with adequate labor, equipment, and material to perform the work requested. The Contractor shall be responsible for all damage incurred to plant material, tree protection, wire, or staking as a result of fire, theft, vehicular damage, or acts of vandalism.

The Contractor shall water all plants as required to sustain them in a healthy condition.

**737.18 Method of Measurement.** The quantity of planting will be measured as the total number of the various species of new plants of each designated height, spread, and diameter, planted as specified in the Contract.

**737.19 Basis of Payment.** The quantity of planting will be paid for at the Contract unit price for each of the various items of planting scheduled in the Contract. Price and payment will constitute full compensation for furnishing and placing all materials, including plants, soil mixes, and mulch; for protecting plants after digging and prior to planting; for staking, excavating plant pits, pruning, wrapping, and guying; for all watering until final acceptance, for the cultural care of the plants until the completion and acceptance of all landscape work; for disposing of excess and waste materials; for replacement planting; for cleanup; for repairs to plant material, tree protection, wire, or staking due to fire, theft, vehicular damage, or acts of vandalism; for repairs to damaged grassed, planted, or other landscaped area due to the Contractor's operations; for ensuring that topsoil meets the sieve analysis, acidity, and organic matter requirements; for applying sufficient materials to fertilizer that originally failed to meet the specified analysis; for using pre- or post-emergent herbicide to control grass and weeds; for the work outlined under Subsection 737.17; and for all labor, equipment, tools, and incidentals required to complete the work.

Payment for the various items of planting as described above may be processed if, in the opinion of the Engineer all work required, except that specified under Subsection 737.17 is satisfactorily completed. No partial payment will be made for any living plants or associated planting material. No additional payment will be made for using plants larger than specified.

On contracts where assessment of time is in working days, the Contractor will be charged working days while engaged in actual planting and directly related work such as plant pit excavation, staking, wrapping, and mulching. The Contractor will not be charged time for indirectly related work such as watering, weed control, pruning, and other responsibilities as described under Subsection 737.17

The cost to remove and replace plants that settle below or rise above the desired finished grades, or that die or are unhealthy as described in Subsection 737.17 shall be the responsibility of the Contractor.

## **SECTION 738 TRANSPLANTING**

**738.01 Description.** This work consists of transplanting trees and shrubs from one site to another within the limits of the right-of-way.

**738.02 Materials.** Existing plants shall be transplanted with appropriate ball diameters as specified on the Plans.

**738.03 Construction Methods.** Vermeer Models TS-84 through TS-20 hydraulic spades, or an approved equal, shall be used for all transplanting work.

The root structure of each plant shall be transplanted as a conically shaped earthen core cut by the hydraulically-operated cutter blades. The spade shall be located so the hydraulically-operated cutter blades are positioned equidistantly from the trunk(s) or stem(s) of the plant being transplanted. The core excavated at the new planting site shall be 2 to 4" (50 to 100 mm) larger than the minimum ball diameter specified so that the plant, when placed, will be slightly below finished grade. All excavated plant pits shall be loosened with a digging iron, mattock, or similar device, to eliminate the hard compacted surface created in digging with a hydraulic spade. All trees or shrubs transplanted shall be tamped lightly around the edge of the ball and approved topsoil added where required by the Engineer to fill any small cracks or voids formed during the transplanting operation. Guying, staking, mulching, and wrapping will be required on all trees and shrubs transplanted as described under Subsection 737.16.

**738.04 Method of Measurement.** The quantity of transplanting will be measured as the total number of the various species of trees and shrubs of each designated height, spread, and diameter actually transplanted as specified in the Contract.

**738.05 Basis of Payment.** The quantity of transplanting will be paid for at the Contract unit price for each height-spread-diameter category of trees and shrubs transplanted. Price and payment will constitute full compensation for furnishing all materials, including soil mixes and mulch; for transplanting all plant materials; for plant establishment according to Subsection 737.17, excluding replacement; for all watering until final acceptance, pruning, and guying; for the cultural care of the plants until the completion and acceptance of all landscape work; for disposing of excess and waste materials; and for all labor, equipment, tools, and incidentals required to complete the work. There will be partial payments for completed work exclusive of plant establishment requirements as determined by the Engineer in accordance with Section 737.

## **SECTIONS 739 and 740 S RESERVED**

### **SECTION 741 TREE REMOVAL**

**741.01 Description.** This work consists of removing and disposing of trees with a diameter over 6" (150 mm).

**741.02 Construction Methods.** The appropriate construction methods of Section 201 shall apply to this work. Removal of additional trees is predicated on damage to the root system.

Final determination and need for removal of additional trees not noted in the Plans will be made by the Engineer during the construction operation when the damage to the root system is determined. It is the intent of this Section to save as many of those additional trees as possible.

For trees which do not fall within proposed pavement, shoulder, or crossover limits, tree removal shall consist of cutting, bucking, and topping trees, the removal of stumps to a depth of not less than 10" (250 mm) below the surrounding ground line, and the removal of all portions or remnants of the tree and stump from highway right-of-way and abutting properties. Trees, which do fall within the proposed pavement, shoulder, or crossover limits shall be completely removed, including stumps and all roots.

All portions or remnants of the tree shall become the property of the Contractor and shall be removed from the right-of-way and abutting properties at the close of each working day. All stumps, which cannot be removed the same day as cutting, shall be cut flush with the ground prior to the end of work that day. All right-of-way removal sites shall be restored to preconstruction condition, satisfactory to the Engineer, if ground disturbance, such as ruts or sod damage, occurs during removal in areas not to be disturbed by grading operations.

**741.03 Method of Measurement.** The quantity of trees for removal will be measured as the actual number of trees acceptably removed.

The trunk diameter of the tree will be measured at a point 4'- 6" (1.4 m) above the ground, and, in the case of multi-trunk trees, the diameter will be measured at the point immediately below the branching split or juncture regardless of the branching height above the ground. The diameter of the tree will be determined from the circumference of the tree as measured above.

**741.04 Basis of Payment.** The quantity of trees designated for tree removal will be paid for at the Contract unit price per each tree by category, as follows:

6" (151 mm)	to	10.9" (279 mm)
11" (280 mm)	to	14.9" (379 mm)
15" (380 mm)	to	18.9" (479 mm)
19" (480 mm)	to	24.9" (639 mm)
25" (640 mm)	to	30.9" (789 mm)
31" (790 mm)	to	36.9" (939 mm)
37" (940 mm)	to	42.9" (1099 mm)
43" (1100 mm)	to	48.9" (1249 mm)
49" (1250 mm)	and larger	

Trees with a diameter of 6" (150 mm) and under will be removed under Section 201.

Price and payment will constitute full compensation for removal of designated trees; for restoration of ground disturbance in right-of-way removal sites; and for all labor, equipment, tools, and incidentals required to complete the work.

## **SECTION 742 S RESERVED**

### **TRAFFIC**

## **SECTION 743 ARROW BOARDS**

**743.01 Description.** This work consists of furnishing and maintaining arrow boards.

### **MATERIALS.**

**743.02 Arrow Boards.** Arrow boards shall be trailer mounted, vehicular mounted, or mounted on any suitable support and shall comply with the requirements of this Section and the Traffic Control Manual, as revised. Arrow boards shall have a nominal size of 48 x 96" (1.2 by 2.4 m) and be equipped with not less than 15 amber lensed, 8800 lumina (minimum), hooded, sealed beam lamps. Lamps shall be arranged to form a double arrow nominally 15" (380 mm) on center horizontally and 10" (250 mm) on center vertically. The rate of flash shall be 30 flashes per minute. Unit controls shall include an intensity adjustment for day/night operation. The back panel of arrow boards shall be equipped with three indicator lamps, visible to the work area, which indicate proper functioning of the board.

**743.03 Trailer.** The trailer for trailer mounted arrow boards shall be designed for support of the sign panel and the power supply unit. The height of the bottom of the sign panel from the roadway shall be 7' (2.1 m) minimum.

**743.04 Controller.** The controller shall provide the following messages:

Right Arrow  
Left Arrow  
Double Arrow  
Warning Light Bar  
Provisions for dimming at night shall be required.

**743.05 Construction Methods.** The arrow boards shall be furnished by the Contractor and shall remain the property of the Contractor. Time and location for use of arrow boards shall be as directed by the Engineer. The arrow message may be transmitted to the motorists by means of simultaneous flashing of the light panel board of sequentially presenting the message.

Throughout the life of the Contract, the Contractor shall maintain the arrow boards and trailers in a good operational condition, including, but not limited to, changing burned out sealed beam units and repairing or replacing any defective parts.

**743.06 Method of Measurement.** The quantity of arrow boards will be measured as the number of each used per day.

**743.07 Basis of Payment.** Arrow boards will be paid for at the Contract unit price for each per day that they are used on the Project, as directed by the Engineer. Price and payment will constitute full compensation for furnishing fuel; for maintaining arrow boards; and for all labor, materials, equipment, and tools required to complete the work. For payment purposes, any part of a day will constitute a full day.



## SECTION 744 CONDUIT JUNCTION WELLS

**744.01 Description.** This work consists of constructing conduit junction wells.

**744.02 Materials.** Materials shall conform to the requirements of the following Section and Subsections:

Brick Masonry	611.06
Castings	708.05
Concrete, Class B	812

**744.03 Construction Methods.** The conduit junction wells shall conform to the dimensions shown on the Standard Construction Details as modified on the Plans, and shall be built high enough to ensure that the castings are properly level with the surrounding surface. Several conduits may extend into the wells.

At the discretion of the Engineer, sod that must be removed for the placement of conduit junction wells shall either be removed by the use of an approved sod cutter and then replaced or 4" (100 mm) of topsoil shall be placed and the surface seeded in accordance with Section 734. In areas where new pavement is to be placed or in areas where total reconstruction is taking place, sodding or seeding may not be required by the Engineer.

**744.04 Method of Measurement.** The quantity of conduit junction wells will be measured as the number of each per type, which are constructed and accepted.

**744.05 Basis of Payment.** The quantity of conduit junction wells will be paid for at the Contract unit price per each. Price and payment will constitute full compensation for furnishing all materials including cast iron lid, frame, topsoil, and grass seed, and for all labor, tools, formwork, equipment, and incidentals required to complete the work. All conduit extending into the junction well will be paid for under Section 745.

## SECTION 745 CONDUITS (NON-METALLIC OR GALVANIZED)

**745.01 Description.** This work consists of installing conduits (non-metallic or galvanized) with all necessary fittings.

**745.02 Materials.** All rigid steel conduits and fittings to be furnished and installed shall be hot-dipped galvanized and conform to the requirements of ANSI C80.1, UL-6, and UL-514. Intermediate metallic conduit shall not be used. Non-metallic 3 and 4" (75 and 100 mm) conduit shall be PVC Schedule 40 pipe meeting specification C5-272-05(PVC).

### 745.03 Construction Methods.

*Under Existing Pavement, Galvanized Conduit.* Conduit shall be installed by jacking, boring, or other approved method, under the existing pavement. It shall be installed with a minimum cover of 24" (600 mm) and a maximum cover of 36" (900 mm). If a 10' (3 m) length of conduit has to be cut, it shall be cut with a pipe cutter, reamed with a pipe reamer, and threaded with a pipe threader. The thread length shall be as necessary to ensure that the sections of conduits, when screwed into a coupling, tighten and butt together when tightened with the appropriate wrenches. If approved by the Engineer, a threadless coupling shall be used to join two lengths of conduits. The threadless coupling shall not be used on a piece of conduit that is to be driven. All cut conduits shall be reamed before a threadless coupling is installed. Conduit shall be terminated 24" (600 mm) beyond the edge of the pavement unless otherwise directed by the Engineer. The standard sheets show typical methods of termination. Ends of all conduit shall be protected with threaded bushings with knockouts. When the jacking or boring is completed, the forward end of the conduit shall be uncovered and compressed air used to clear all foreign matter before inspection. The Contractor shall be responsible for correcting any existing conduit which is disturbed during construction. Each conduit shall have a 10 gage (3.4 mm) galvanized fish wire left in for future use. In instances where the Contractor installs the cable, the fish wire may be eliminated.

The size of a bore made under the pavement shall not exceed the outside diameter of the pipe by more than 1" (25 mm). If it does, cement grout shall be pumped into the void around the outside of the pipe.

At the discretion of the Engineer, sod that must be removed for the placement of conduits shall either be removed by the use of an approved sod cutter and then replaced or 4" (100 mm) of topsoil shall be placed and the surface seeded in accordance with Section 734. In areas where new pavement is to be placed or in areas where total reconstruction is taking place, sodding or seeding may not be required by the Engineer.

Elbows of rigid steel conduit manufactured by the Contractor with a hydraulic bender will be acceptable provided that a smooth radius of the proper dimension is achieved and the galvanizing is not damaged.

*Under Existing Pavement, PVC Conduit.* Conduit shall be placed by jacking, boring, or other approved method, under the existing pavement. It shall be installed with a minimum cover of 18" (450 mm) and a maximum cover of 25" (640 mm) as measured from the top of the finished pavement. It shall be extended from the specified location under the roadway to a conduit junction well as specified. The pipe shall slope slightly toward the junction well. Joints shall be squared, reamed, and shall be fully set and cemented, with the upper end covered with a manufactured cap or plug and the lower end open. Conduit shall be flush with the inside wall of the junction well.

The size of the bore made under the pavement shall not exceed the outside diameter of the pipe by more than 1" (25 mm). If it does, cement grout shall be pumped into the void around the outside of the pipe.

At the discretion of the Engineer, sod, that must be removed for the placement of conduits, shall either be removed by the use of an approved sod cutter and then replaced or 4" (100 mm) of topsoil shall be placed and the surface seeded in accordance with Section 734. In areas where new pavement is to be placed or in areas where total reconstruction is taking place, sodding or seeding may not be required by the Engineer.

*Under New Pavement, Galvanized and PVC Conduit.* Conduit shall be installed directly in the earth with a minimum cover of 24" (600 mm) and maximum cover of 36" (900 mm). If a 10' (3 m) length of conduit has to be cut, it shall be cut with pipe cutter, reamed with a pipe reamer, and threaded with a pipe threader. The thread length shall be as necessary to ensure that the section of conduits, when screwed into a coupling, tighten and butt together when tightened with the appropriate wrenches. If approved by the Engineer, a threadless coupling shall be used to join two lengths of conduit. All cut conduits shall be reamed before a threadless coupling is installed. Conduit shall be terminated 24" (600 mm) beyond the edge of the pavement unless otherwise directed by the Engineer. The standard sheets show typical methods of termination. Ends of all conduits shall be protected with threaded pipe bushings with knockouts after compressed air has been used to clear all foreign matter. Backfill in conduit trenches shall be compacted thoroughly as it is being placed. Each empty conduit shall have a 10 gage (3.4 mm) galvanized fish wire left in for future use. In instances where the Contractor installs the cable, the fish wire may be eliminated.

At the discretion of the Engineer, sod, that must be removed for the placement of conduit, shall either be removed by the use of an approved sod cutter and then replaced or 4" (100 mm) of topsoil shall be placed and the surface seeded in accordance with Section 734. In areas where new pavement is to be placed or in areas where total reconstruction is taking place, sodding or seeding may not be required by the Engineer.

Elbows of rigid steel conduit manufactured by the Contractor with a hydraulic bender will be acceptable provided that a smooth radius of the proper dimension is achieved and that the galvanizing is not damaged.

**745.04 Method of Measurement.** The quantity of non-metallic or galvanized conduit will be measured in linear feet (linear meters) of conduit, in place and accepted.

**745.05 Basis of Payment.** The quantity of non-metallic or galvanized conduit will be paid for at the Contract unit price per linear foot (linear meter), for the size used. Price and payment will constitute full compensation for furnishing and installing all materials, and for all labor, equipment, tools, and incidentals required to complete the work.

## **SECTION 746 POLE BASES**

**746.01 Description.** This work consists of furnishing pole bases Types 1, 2, 2A, 2B, 3, 3A, 3B, 4, 5, and 6 for poles at locations as directed by the Engineer.

**746.02 Materials.** The concrete for pole bases shall conform to Section 812, Class B. Bar reinforcement shall meet the requirements of Section 603 Grade 60 (Grade 420). Ground rods shall be copper covered, approved by the Underwriters' Laboratory and be supplied with approved clamps for connecting the grounding conductor to the rod. Conduit for sweeps shall meet the requirements for galvanized rigid steel conduit in Section 745. Anchor bolts will be supplied by the Department for Types 1, 2, 2A, 2B, 3A and 3B bases and will be supplied by the District Engineer in charge of the project. For Types 4, 5, and 6, the Contractor shall supply the anchor system as indicated on the Standard Construction Details and as directed by the Engineer. The anchor bolts and nuts for Types 5 and 6 shall be hot-dipped galvanized and meet the requirements of AASHTO M 314. Anchor bolts shall have a minimum yield strength of 55,000 psi (379 MPa).

**746.03 Construction Methods.** The bases shall conform to the dimensions as indicated on the Standard Construction Details. A ground rod shall be installed as shown. A minimum of 6' (1.8 m) of the ground rod must be driven into undisturbed soil.

If a utility or a right-of-way conflict is found when a Type 2 or Type 3 base is specified in the Plans, an alternate base of equivalent strength may be used as directed by the Engineer. A Type 2 base has two equivalents, namely Types 2A and 2B. A Type 3 base has two equivalents, namely Types 3A and 3B.

Though the Contract calls for the use of a round pole base, the Contractor may use a square base at its discretion. Excavation for the pole bases may not exceed the dimension of the foundation by more than 12" (300 mm) in any one direction. If a form is used in the excavation more than 18" (450 mm) below the ground surface, it is necessary that the area between the form and the excavation be filled and tamped on all sides in layers not to exceed 6" (150 mm). Where a pole base is to be placed in existing concrete pavement such as a sidewalk, the concrete shall be saw cut in a square pattern or removed to the nearest joint. In other pavement material, a round hole may be cut using an appropriate tool. Any damage to existing pavement shall be repaired. The repair will be approved by the Engineer.

The bases shall be edged and have a broom finish.

**746.04 Method of Measurement.** The quantity of pole bases will be measured as the actual number of bases constructed.

**746.05 Basis of Payment.** The quantity of pole bases will be paid for at the Contract unit price for each pole base type. If an alternate base type is selected by the Engineer, payment will be the Contract unit price for the alternate selected. Price and payment will constitute full compensation for furnishing and placing all materials; for a minimum of two conduit sweeps extending into the base; for excavating, backfilling, and compacting around the base; for repairs to damaged existing pavement; for removal or replacement of pavement; and for all labor, equipment, tools, and incidentals required to complete the work.

Payment for any additional sweeps will be paid for under Section 745.

The Contractor's use of square base rather than a specified round base shall not result in any additional cost to the Department.

## **SECTION 747 CABINET BASES**

**747.01 Description.** This work consists of installing cabinet bases.

**747.02 Materials.** The concrete for cabinet bases shall conform to Section 812, Class B. The ground rod shall be at minimum a 3/4" (19 mm) diameter by 10' (3 m) copper covered ground rod approved by the Underwriters' Laboratories and include an approved clamp for connecting the grounding conductor to the rod. The Contractor shall supply the anchoring system for the cabinet bases. The anchoring system shall consist of four 5/8" (M16) inserts and four galvanized 5/8" (M16) hex bolts, 12" (38 mm) long.

**747.03 Construction Methods.** The bases shall conform to the dimensions as shown on the Standard Construction Details. A minimum of 6' (1.8 m) of the ground rod must be driven into undisturbed soil. Conduits entering the base must enter only in the designated area. A minimum distance of 1" (25 mm) shall be maintained between conduits and a minimum distance of 2" (50 mm) between conduits and the ground rod.

The bases shall be formed to the full depth or as directed by the Engineer. Where conduit had previously been installed, connection to the conduit in the base shall be made before placing concrete. Conduit sweeps shall be placed in the base as indicated on the Plans and the Standard Construction Details. All bases shall be constructed with one capped spare conduit sweep in addition to all conduit sweeps shown on the Plans. An arrow shall be placed on the surface of the outer edges of the base indicating where each conduit leaves the base. Conduit sweeps shall be 90 degree elbows with smooth 24" (600 mm) radii and undamaged galvanizing.

**747.04 Method of Measurement.** The quantity of cabinet bases will be measured as the actual number of cabinet bases constructed.

**747.05 Basis of Payment.** The quantity of cabinet bases will be paid for at the Contract unit price per each. Price and payment will constitute full compensation for furnishing and placing all materials; for excavating and backfilling around the bases; and for all labor, equipment, tools, and incidentals required to complete the work. All conduit sweeps in the base will be paid for under Section 745.

## SECTION 748 PAVEMENT MARKINGS

**748.01 Description.** This work consists of supplying and installing pavement markings on the individual lifts of pavement material and the final surface of the roadway.

**748.02 Definitions.** There shall be two types of pavement markings as described below:

1. *Temporary Markings.* Temporary markings, which replace those removed by milling or planing of pavement, are placed on individual sublifts of paving materials or on final travel surfaces, and which are kept in service for less than four weeks. Temporary markings shall be applied as specified in the Traffic Control Manual.
2. *Permanent Markings.* Permanent markings are usually placed on the final travel surface. Permanent markings shall always be applied in accordance with the MUTCD.

Any of the two types of markings may be used in the following applications except as limited by the MUTCD.

3. *Lane Line.* Lines of marking material placed between lanes of traffic.
4. *Edge Line.* Lines of marking material placed on the right hand side of a travel lane with two way traffic or both sides of a traveled way having one way traffic.
5. *Center Line.* Lines of marking material placed between lanes of traffic traveling in opposite directions.
6. *Detour Markings.* Markings which are placed to cause or require traffic to move from the normal or previous travel path. All detour markings shall be installed using standard marking patterns as specified in the MUTCD.
7. *No Passing Zones.* Any centerlines between opposing directions as on a multilane highway shall be applied in accordance with the MUTCD, or as directed by the Engineer, for all temporary or permanent markings.

## MATERIALS.

**748.03 Approved Materials.** The Department periodically conducts tests of various pavement marking materials to determine which materials are suitable for use on Delaware roads. A list of approved materials is available from the Engineer. There is no approved list of materials for temporary paint. The paint used for temporary marking need only be paint intended for use on roadway materials and retain sufficient amounts of beads to remain reflective.

**748.04 Alkyd Type Thermoplastic Material.** The thermoplastic material that is available in white and highway yellow shall be homogeneously composed of pigment, filter, resins, and glass reflectorizing spheres. It shall melt uniformly with no evidence of skins or unmelted particles. It shall not deteriorate on contact with sodium chloride, calcium chloride, or other de-icing chemicals or because of oil content of paving materials or oil drippings. It shall be tested in accordance with AASHTO T 250 and M 249 or with the appropriate method in FED-STD-141C or ASTM designation.

The thermoplastic material shall be suitable for application immediately after compaction of the final lift of asphaltic concrete. The thermoplastic shall be neither permanently discolored nor softened by contact with hot-mix bituminous concrete.

The white thermoplastic material shall not exceed a yellowness index of 0.15.

The yellow color shall reasonably match color chip No. 13538 of FED-STD-595B. The test shall be performed at 77 EF (25 EC).

1. *Alkyd Binder.* The binder shall consist of mixture of synthetic resins, at least one of which is solid at room temperature, and high boiling point plasticizer. At least one-third of the binder composition shall be solid maleic-modified glycerol ester resin and shall be no less than 18% by weight of the entire material formulation. The binder shall not contain petroleum based hydrocarbon resins.
2. *Composition.* The pigment, glass beads, and filler shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt, and foreign materials or objects and shall comply with the following requirements.

**Composition (percent by weight)**

<i>Component</i>	<i>White</i>	<i>Yellow</i>	<i>Black</i>
Alkyd Binder	18.0 minimum	18.0 minimum	18.0 minimum
Glass Beads	30 - 40	30 - 40	0.0 maximum
Titanium Dioxide	10.0 minimum	---	0.0 maximum
Calcium Carbonate and Inert Fillers	42.0 maximum	50.0 maximum 50.0 maximum	52.0 maximum
Yellow Pigment	52.0 maximum		---

See Note (a)

Note (a): Amount of yellow pigment, calcium carbonate, and inert fillers shall be at the option of the manufacturer, providing all other requirements of this specification are met.

**3. Physical Characteristics.**

1. *Specific Gravity.* The specific gravity of the thermoplastic traffic line material shall not exceed 2.15.
2. *Storage Life.* Any unused material which does not conform to the requirements of the specification for a period of one year shall be replaced by the manufacturer at no cost to the Department.
3. *Set Time.* When applied at a temperature range of 412 " 12 °F (211 " 7 °C) and at a thickness of 0.0625 to 0.125" (1.5 to 3.0 mm), the material shall set to bear traffic in not more than two minutes when the air temperature at 50 " 4 °F (10 " 2 °C), and not more than ten minutes when the air temperature is 90 " 4 °F (32 " 2 °C).
4. *Color.\** Daylight reflectance at 45 degrees - 0 Degrees:

White: 75%  
Yellow: 45%

5. *Bond Strength.\** The bond strength to the pavement shall exceed 1,800 psi (1.24 MPa).
6. *Resistance to Cracking at Low Temperature.\** Applied to concrete blocks, and cooled to 201 " 4 EF (94 " 2 EC), the material shall show no cracks.
7. *Impact Resistance.\** The impact resistance shall be a minimum of 10 in@lb (1.13 N@m) upon test specimens.
8. *Softening Point.\** Tested in accordance with ASTM D 36, the materials shall have a softening point of 216 " 14 EF (102 " 8 EC).
9. *Flowability.\** Tested for flowability, the white thermoplastic shall have a maximum residue of 18% and the yellow thermoplastic shall have a maximum residue of 21%.
10. *Flowability Extended Heating.\** After extending the heat period by four hours and 30 minutes, when tested for flowability, the thermoplastic shall have a maximum residue of 28%.

\* For the tests (d) through (j), the thermoplastic material shall be heated under agitation for four hours plus or minus five minutes at 424 " 4 EF (218 " 2 EC) prior to the start of the test.

**748.05 Glass Spheres.**

1. *Pre-Mixed in the Material.* The glass spheres shall be uncoated and shall conform to the requirements of AASHTO M 247, Type 1.
2. *Surface Applied.* The glass spheres shall conform to the requirements of AASHTO M 247, Type 1, except that the beads must be moisture resistant coated to conform to the requirements of procedure 4.4.2 (AASHTO M

247) and a maximum of 5% shall pass the No. 80 sieve (180 µm) screen. Glass spheres shall have a minimum of 70% true spheres on each sieve and 80% true spheres overall.

**748.06 Packaging and Marking.** The thermoplastic material shall be packaged in suitable containers to which it will not adhere during shipment and storage. The container of thermoplastic material shall weigh approximately 50 lb (23 kg). Each container shall designate the color, binder (alkyd), spray or extrude, user information, manufacturer's name and address, batch number, and date of manufacture. Each batch manufactured shall have its own separate number. The label shall warn the user that the material must be heated in the range of 400 to 440 °F (204 to 227 °C).

**748.07 Vendor Qualification.** In order to be eligible to supply the required pavement marking materials, evidence of three years successful services for alkyd-based materials in transverse and/or symbol applications shall be provided in writing. Successful service shall be evidenced by color stability, retention of retroreflective properties, crack resistance, and lack of softening or permanent discoloration due to exposure to oil and grease drippings for the required three year period. The documentation must be from three projects in areas with similar climactic conditions within the United States.

**748.08 Equipment.** The equipment used to apply pavement markings shall conform to the following requirements:  
*Paint Equipment.*

1. Shall be able to apply double centerlines simultaneously (except temporary markings may be applied separately).
  - a. Shall be capable of applying paint and glass beads to pavement at same time, leaving no more than 2" (50 mm) of painted line without glass beads at the beginning or end of a line.
  - b. Shall be capable of hand gun operation for applying special markings. (This may be a separate piece of equipment.)
2. *Truck Mounted Paint Equipment.*
  - a. Shall have steerable gun carriages.
  - b. Must be able to apply double centerlines simultaneously.
  - c. Shall be capable of pneumatically applying glass beads 1" (25 mm) behind the spray pattern of the paint gun.
  - d. Shall have an automatic, electrically controlled skipline mechanism capable of retracing the existing 10' (3 m) stripe and 30' (9 m) skip or applying a new 10' (3 m) stripe and 30' (9 m) skip.
3. *Thermoplastic Equipment.*
  - a. Shall provide for constant mixing and agitation of the material.
  - b. Shall apply the material to the road surface in a molten state at the temperature specified in Subsection 748.08 (c)(1) by screed extrusion means.
  - c. Shall apply glass beads instantaneously upon the installed line to ensure adhesion.

**748.09 Application.**

- a. *General.* The Contractor shall protect all pavement markings until track free. In the event any vehicle should cross wet pavement markings, the damaged markings shall be removed by sand blasting, heat, or other methods acceptable to the Department and replaced.

All necessary markings shall be installed before the end of the workday. Whenever work is interrupted by weather, the markings shall be installed as soon as possible. Due to safety requirements, this Section shall overrule Subsection 101.39 which prevents work on holidays.

The Contractor shall furnish to the Department the applicable warranty for the material to be installed to ensure proper performance.

Thermoplastic pavement markings shall not be applied on Portland cement concrete and other concrete

surfaces.

b. *Paint.*

1. This specification is to cover the application of pigmented binder (white and yellow) and optical glass spheres system to the highway surface with specialized equipment.
2. The reflective surface shall be obtained by applying optical glass spheres at the rate of 5 lb/gal (0.6 kg/L) of paint onto and into the pigmented binder in one operation as specified under this Subsection. The number of gallons (liters) of paint used and the number of pounds (kilograms) of beads used shall be determined. Rate application will be calculated by dividing the gallons (liters) of paint used for the day into the number of pounds (kilograms) of beads used for the day, and the result should be 5 lb/gal (0.60 kg/L) within "2%. If the result does not meet this limit, the days work shall be redone.
3. Pigmented binder (paint), white or yellow, shall be applied by the Contractor according to the paint manufacturer's recommendations. The paint shall only be applied when ambient air temperature is 40 °F (4 °C) or higher. The wet film thickness shall be 0.015 " 0.001" (0.38 " 0.03 mm).

c. *Thermoplastic Alkyd Type Material.*

1. *Application.* For optimum adhesion, the thermoplastic material shall be installed in a molten state at a temperature between 400 to 425 °F (204 to 218 °C) on a clean, dry, and solvent free surface. The Contractor shall clean off pavement surface dirt and grease where necessary by approved removal methods. Thermoplastic pavement marking materials shall not be applied when pavement temperatures are below 50 °F (10 °C) or when the surface of the pavement shows evident moisture.

A primer sealer if recommended by the manufacturer of the thermoplastic material shall be applied prior to the installation of thermoplastic material on the pavement if required by the Department. The primer shall be void of solvent and water prior to the installation of thermoplastic material.

The material shall readily apply to the pavement from either manual or self propelled application equipment by the screed/extrusion method wherein one side of the shaping die is the pavement and the other three sides are contained by a part of suitable equipment for heating and controlling the flow of material.

The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly upon any type of old thermoplastic line, provided that the initial material was properly bonded, or on worn paint line showing considerable pavement exposure. Such new material shall bond itself to the old line in such a manner that no splitting or separation takes place.

The application equipment shall conform to the requirements of this Subsection and be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be accomplished in a true arc. The heating kettle and application equipment shall conform to the requirements of the National Fire Underwriters of the National Fire Protection Association and of the State.

The equipment used to install hot applied thermoplastic material by contract under this Section shall be constructed to provide continuous uniform heating to temperatures exceeding 400 °F (204 °C), mixing, and agitation of the material. The conveying parts of the equipment between the main material reservoir and the line dispensing device shall prevent accumulation and clogging. All parts of the equipment which come in contact with the material shall be constructed for easy accessibility for cleaning and maintenance. The equipment shall operate so that all mixing and conveying parts, including the line dispensing aprons or similar appliances which the dispenser overruns, will not be permitted. The equipment shall provide for traffic marking application of varying widths in even multiples of 4 or 6" (100 or 150 mm).

Glass spheres shall be applied to the surface of the completed stripe by drop-on or pressure spray methods at an approximate uniform rate of 0.100 lb of glass spheres every square foot

(0.49 kg of glass spheres every square meter) [0.033 lb/ft of 4" (50 g/m of 100 mm)] from automatic dispenser attached to the striping machine so that the glass spheres are dispensed closely behind the installed line. The glass sphere dispenser shall be equipped with an automatic cut-off control synchronized with the cut-off of the thermoplastic material.

2. *Patterns.* The thickness measurement prior to application of drop-on glass beads shall be 0.125" (3.18 mm) for crosswalks and stop bars and 0.090" (2.28 mm) for lanelines, centerlines, and edgelines.

Calibration shall be done by placing black tapes, film, or metal plates of known and uniform thickness in the area to be striped. Once the striper has passed over, the sample is removed by making sharp cuts with a knife and measurement of the stripe plus base are made with a micrometer or vernier calipers with a proper correction for the base.

For longitudinal lines, these thickness checks shall be made every 1,600' (500 m) or more frequently at the judgment of the Engineer. For symbols and intersection markings, the frequency of checking shall be at the option of the Engineer. These thicknesses shall be considered as the average of two or more measurements made in a 3' (1 m) distance.

Longitudinal lines shall be offset at least 2" (50 mm) from construction joints and 2" (50 mm) to the inside of shoulder breaks of pavement. Openings 6" (150 mm) in length shall be provided at 20' (6 m) intervals in edgelines placed on the inside of super elevated curves to prevent ponding of water on the pavement surface.

The finished lines shall have well defined edges.

The typical skip pattern shall be based on a 40' (12 m) cycle made up of a 10' (3 m) painted surface and a 30' (9 m) space.

d. *Reflectivity for Paint and Alkyd Type Thermoplastic Material.*

After satisfactory completion of all striping work and written notification from the Contractor, the Department will test the striping to ensure it has the minimum reflectivity. The testing will be completed within 30 calendar days from notification. The Contractor shall accept lower average readings derived from late testing due to the Contractor's failure to notify the Engineer. The Contractor may request that tests be conducted on completed phases or portions of the work. Approval of such a request will be at the discretion of the Engineer. Testing will be done using a Delta LTL 2000 Retrometer (30 meter geometry). Five readings will be taken per line per 1 mile (1.6 kilometer). Projects less than 1 mile (1.6 kilometer) in length will have a minimum of five readings per line.

The required minimum initial reflectivity reading in millicandellas for alkyd thermoplastic markings shall be:

White 300

Yellow 200

For alkyd thermoplastic markings below these minimums and above 125 millicandellas, payment will be reduced as described under Basis of Payment.

All markings (paint and alkyd thermoplastic) with an average reflectivity below 125 millicandellas shall be removed and replaced at the sole expense of the Contractor.

e. *Guarantee for Alkyd Type Thermoplastic Material.*

Acceptance of this project will be contingent upon successful completion of a 180 day observation period under traffic beginning upon the satisfactory completion of all striping work required by the Contract.

During the 180 day observation period the thermoplastic Pavement Marking Material furnished and installed under this Contract shall be warranted against failure due to blistering, excessive cracking, bleeding, staining, discoloration, oil content of the pavement materials, smearing and spreading under heat, deterioration due to contact with grease deposits, oil, diesel fuel, or gasoline drippings, chipping, spalling, poor adhesion to the pavement materials, vehicular damage, and wear. Any markings that have not performed satisfactorily during



the 180 day observation shall be replaced by the Contractor at no expense to the Department.

Marking replacement shall be performed in accordance with the requirements specified herein for the initial application, including but not limited to possible surface cleaning, pavement marking removal, seasonal and weather limitations, etc.

The Contractor shall replace or renew, entirely at his/her expense, the amount of pavement markings deemed by the Engineer to have failed to perform useful service during the period noted above. The replacement material installed under this guarantee shall be the same as the original material.

**748.10 Method of Measurement.** The different types of pavement markings will be measured as follows:

1. *Temporary Markings.* The quantity of temporary pavement markings will be measured by the linear foot (linear meter) of 4 or 6" (100 or 150 mm) line and by the square foot (square meter) for symbols, installed and accepted.
2. *Permanent Markings.* The quantity of permanent pavement markings will be measured by the linear foot (linear meter) of 4 or 6" (100 or 150 mm) line and by the square foot (square meter) for symbols, installed and accepted.

The linear foot (linear meter) of 4 or 6" (100 or 150 mm) line refers to all 4 or 6" (100 or 150 mm) lines parallel to the centerline. The square foot (square meter) of symbols refers to all STOP bars, transverse lines, arrows, and words. All symbols will be measured according to the following square foot (square meter) values.

Straight Arrow	12.5 ft <sup>2</sup> (1.2 m <sup>2</sup> )
Left and Right Arrow Symbol	15.5 ft <sup>2</sup> (1.4 m <sup>2</sup> )
Combination Arrow	20 ft <sup>2</sup> (1.9 m <sup>2</sup> )
"Only" Legend	23 ft <sup>2</sup> (2.1 m <sup>2</sup> )
"School" Legend	35 ft <sup>2</sup> (3.3 m <sup>2</sup> )
"Stop" Legend	23.5 ft <sup>2</sup> (2.2 m <sup>2</sup> )
8" (200 mm) Transverse Line	0.66 ft <sup>2</sup> per linear foot (0.20 m <sup>2</sup> , per linear meter)
12" (300 mm) Transverse Line	1.00 ft <sup>2</sup> per linear foot (0.30 m <sup>2</sup> , per linear meter)
16" (400 mm) Transverse Line	1.33 ft <sup>2</sup> per linear foot (0.41 m <sup>2</sup> , per linear meter)
24" (600 mm) Transverse Line	2.00 ft <sup>2</sup> per linear foot (0.61 m <sup>2</sup> , per linear meter)
"R X R" Railroad Crossing Symbol	69 ft <sup>2</sup> (6.4 m <sup>2</sup> )

**748.11 Basis of Payment.** The quantity of temporary and permanent paint pavement marking will be paid for at the Contract unit price per linear foot (linear meter) for 4 or 6" (100 or 150 mm) line and the Contract unit price per square foot (square meter) of symbol. The quantity of permanent alkyd thermoplastic pavement marking will be paid for at the Contract unit price per linear foot (linear meter) of line and the Contract unit price per square foot (square meter) of symbol unless payment is reduced due to below minimum reflectivity as described below:

For alkyd thermoplastic pavement markings with reflectivity readings of 125 millicandellas or above but below 300 millicandellas for white or 200 millicandellas for yellow payment will be pro-rated based on the following formula:

$$\frac{A \times B}{C}$$

A = Average measured reflectivity readings\*

B = Contract bid price for striping \*\*

C = Required minimum initial reading

\* = Must be greater than or equal to 125 millicandellas

\*\* = Item bid price; not material cost

Price and payment will constitute full compensation for furnishing and installing all materials; for preparation of the pavement; for replacement of reflective surface that does not conform to the application rate specified in Subsection 748.08 for removal and repair of markings damaged by vehicles crossing wet markings; and for all labor, tools, equipment, and incidentals required to complete the work.

## **SECTION 749 REINFORCED CONCRETE SIGN FOUNDATIONS**

**749.01 Description.** This work consists of constructing reinforced Portland cement concrete foundations for sign structures.

**749.02 Materials.** Materials for reinforced concrete sign foundations shall conform to the following Sections:

**749.03**

Backfill Material, Borrow Type G	209
Portland Cement Concrete, Class A	812
Bar Reinforcement	824

**749.03 Construction Methods.** Construction of reinforced concrete sign foundations shall conform to Section 602, except as permitted herein. The exact field location of reinforced concrete sign foundations will be designated by the Engineer prior to beginning work.

Excavation shall be made to the required dimensions by a method acceptable to the Engineer. Excavated areas not occupied by Portland cement concrete shall be of sufficient width, if not otherwise specified, to permit the placement and compaction of backfill material. All backfill material shall be placed and compacted to 95% or more in accordance with Section 202.

**749.04 Method of Measurement.** The number of reinforced concrete sign foundations will be measured as the actual number of reinforced concrete sign foundations and accepted.

**749.05 Basis of Payment.** The quantity of reinforced concrete sign foundations will be paid for at the Contract unit price per each. Price and payment will constitute full compensation for furnishing all materials, including fittings and backfill material; for forming, sheeting, and shoring; for excavating, backfilling, compacting, and disposing of surplus materials; and for all labor, equipment, tools, and incidentals required to complete the work. Rock excavation will be paid for under Section 206.

## **SECTION 750 ADJUSTING WATER VALVE BOXES**

**750.01 Description.** This work consists of adjusting water valve boxes.

**750.02 Materials.** Materials for adjusting water valve boxes shall conform to the following Sections:

**750.03**

Backfill Material, Borrow Type C	209
Portland Cement Concrete, Class B	812
Stone, Delaware No. 8	813

All pipe, fittings, and hardware shall conform to the requirements shown on the Plans and to the standards and specifications of the utility owner.

**750.03 Construction Methods.** All metal boxes shall be adjusted to grade with repairs performed as required and as directed by the Engineer. Water valve boxes shall be adjusted in accordance with the details shown on the Plans and the standards and specifications of the utility owner, and as directed by the Engineer. The Contractor shall acquaint itself with these standards and specifications prior to the submission of a proposal for the construction of the work included in the Contract documents. The location of the water valve boxes shall be as shown on the Plans. The materials necessary to be excavated under these items shall be removed from the site. All such excavations shall be backfilled with approved materials.

**750.04 Method of Measurement.** The quantity of water valve boxes adjusted will be measured as the actual number of water valve boxes adjusted and accepted.

**750.05 Basis of Payment.** The quantity of adjusted water valve boxes will be paid for at the Contract unit price per each. Price and payment will constitute full compensation for furnishing and placing all materials; for removing any covers or portions of structures; for excavating, backfilling, compacting, and disposing of surplus material; for resetting the valve boxes to proper grades; and for all labor, equipment, tools, and incidentals required to complete the work. Any damage to the water valves or boxes caused by the Contractor shall be repaired at the Contractor's expense.

## **SECTION 751 ADJUSTING FIRE HYDRANTS**

**751.01 Description.** This work consists of adjusting fire hydrants.

**751.02 Materials.** Materials for adjusting fire hydrants shall conform to the following Sections:

Backfill Material, Borrow Type C	209
Portland Cement Concrete, Class B	812
Stone, Delaware No. 8	813

All pipe, fittings, and hardware shall conform to the requirements shown on the Plans and to the standards and specifications of the utility owner.

**751.03 Construction Methods.** Fire hydrants shall be adjusted in accordance with the details shown on the Plans and the standards and specifications of the utility owner, and as directed by the Engineer. The Contractor shall acquaint itself with these standards and specifications prior to the submission of a proposal for the construction of the work included in the Contract documents. The location of the fire hydrants shall be as shown on the Plans, but the exact position of the adjusted hydrants shall be determined in the field.

**751.04 Method of Measurement.** The quantity of fire hydrants adjusted will be measured as the actual number of fire hydrants adjusted and accepted.

**751.05 Basis of Payment.** The quantity of fire hydrants adjusted will be paid for at the Contract unit price per each. Price and payment will constitute full compensation for all materials, including concrete, stone, and any contingent materials relative and necessary to the work; for all excavating, backfilling, testing, compacting, and disposing of excess material; and for all labor, equipment, tools, and incidentals required to complete the work. Any valves, fittings, connections, or joints determined by the Engineer to be unsuitable for reuse shall be replaced at the Contractor's expense.

## **SECTION 752 RELOCATING FIRE HYDRANTS**

**752.01 Description.** This work consists of relocating fire hydrants.

**752.02 Materials.** Materials for relocating fire hydrants shall conform to the following Sections:

Backfill Material, Borrow Type C	209
Portland Cement Concrete, Class B	812
Stone, Delaware No. 8	813

Valve boxes, tie rods, pipe, bends, miscellaneous fittings, and hardware required to relocate the fire hydrants shall conform to the requirements shown on the Plans and to the standards and specifications of the utility owner.

**752.03 Construction Methods.** Fire hydrants shall be relocated in accordance with the details shown on the Plans and the standards and specifications of the utility owner, and as directed by the Engineer. The Contractor shall acquaint itself with these standards and specifications prior to the submission of a proposal for the construction of the work included in the Contract documents. The location of the existing hydrants and the approximate position of the relocated hydrants shall be as shown on the Plans. The work shall be performed under the supervision and with the approval of the owner of the utility.

**752.04 Method of Measurement.** The quantity of fire hydrants relocated will be measured as the actual number of fire hydrants relocated and accepted.

**752.05 Basis of Payment.** The quantity of fire hydrants relocated will be paid for at the Contract unit price per each. Price and payment will constitute full compensation for all materials, including concrete, stone, valve boxes, tie rods, pipe, bends, and any contingent materials relative and necessary to the work; for all excavating, backfilling, compacting, and disposing of excess material; and for all labor, equipment, tools, and incidentals required to complete the work.

## **SECTION 753 ADJUSTING SANITARY SEWER LATERALS**

**753.01 Description.** This work consists of adjusting sewer connections that interfere with the proposed construction or which are damaged by unavoidable construction operations.

**753.02 Materials.** Materials for adjusting sanitary sewer laterals shall conform to the following Sections:

Backfill Material, Borrow Type C	209
Portland Cement Concrete, Class B	812
Stone, Delaware No. 8	813

All pipe, fittings, and hardware shall conform to the requirements shown on the Plans and to the standards and specifications of the utility owner.

**753.03 Construction Methods.** All sewer connections shall be adjusted in accordance with the details shown on the Plans and the standards and specifications of the utility owner, and as directed by the Engineer. The Contractor shall acquaint itself with these standards and specifications prior to the submission of a proposal for the construction of the work included in the Contract documents. The location of the sewer connections shall be as shown on the Plans. No lateral changes shall be made without the approval of the Engineer or the Engineer's authorized representative. All existing sanitary or combined sewers must be retained in service during construction and until acceptance of portions of new replacement facilities. Temporary piping, if necessary, shall be utilized to maintain service during construction. All construction shall be coordinated with and written approval obtained from the utility owner prior to the interruption for temporary connections or new facilities of existing sanitary or combined sewers.

**753.04 Method of Measurement.** The quantity of sanitary sewer laterals adjusted will be measured as the actual number of laterals adjusted and accepted.

**753.05 Basis of Payment.** The quantity of sanitary sewer laterals adjusted will be paid for at the unit price per each. Price and payment will constitute full compensation for all necessary excavating, backfilling, compacting, and disposing of excess material; for all cribbing, shoring, and sheeting; for furnishing and installing pipe and fittings regardless of size; for concrete encasement of fittings, regardless of size; for concrete encasement of fittings and joints, if required; and for all material, labor, equipment, tools, and incidentals required to complete the work.

## SECTION 754 ADJUSTING WATER SERVICES

**754.01 Description.** This work consists of adjusting the water line services to private properties.

**754.02 Materials.** Materials for adjusting water services shall conform to the following Sections:

Backfill Material, Borrow Type C	209
Portland Cement Concrete, Class B	812
Stone, Delaware No. 8	813

All pipe, fittings, and hardware shall conform to the requirements shown on the Plans and to the standards and specifications of the utility owner, or as directed by the Engineer.

**754.03 Construction Methods.** The plumbing work required under this Section must be performed in accordance with applicable codes and industry standards.

Water services shall be adjusted in accordance with the details shown on the Plans and the standards and specifications of the utility owner, and as directed by the Engineer. The Contractor shall acquaint itself with these standards and specifications prior to the submission of a proposal for the construction of the work included in the Contract documents.

The Contractor shall install water services and appurtenances of the sizes and to the lines required, and as designated by the Engineer.

Proper and suitable tools and appliances for the safe and convenient handling and laying of pipe and fittings shall be used. Pipe, fittings, and other appurtenances shall be carefully handled and lowered into the trench. The ends of the pipe shall abut against each other in such a manner that there shall be no unevenness on the inside of the pipe. Special care shall be taken to ensure that the pipes are well bedded on a solid foundation. Any defects due to settlement shall be repaired by the Contractor. A special precaution shall be exercised to prevent any pipe from resting on rock.

The pipes and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed work. At the close of work each day, the end of the pipe lines shall be tightly closed with a suitable

stopper so that no dirt or foreign substances can enter the pipe. The stopper shall be kept in place until pipe laying is again resumed.

Whenever a pipe or fitting requires cutting to fit in the line or to bring it to the required location, the work shall be done in a satisfactory manner so as to leave a smooth end.

Completed water services shall be tested for leakage. No leakage shall be allowed. The minimum test pressure shall be the same as mainline water pressure. Testing shall conform to the requirements of the utility owner within each municipality.

If the service indicates any leakage whatsoever, the Contractor shall repair the leaks or defects and, if so directed, retest the line after the correction of defects. This testing and correcting of defects shall continue until all leaks have been stopped.

Leaks and defects shall be repaired or otherwise remedied by the Contractor to the complete satisfaction of the Engineer, at whatever time leaks or defects become apparent, prior to the final acceptance of the work.

All excess material shall be removed from the Project site or otherwise disposed of as specified in Subsection 106.09. Trench restoration shall include seeding, sodding, or plant replacement, as necessary.

**754.04 Method of Measurement.** The quantity of water services adjusted will be measured as the actual number of water services adjusted and accepted.

**754.05 Basis of Payment.** The quantity of water services adjusted will be paid for at the Contract unit price per each. Price and payment will constitute full compensation for furnishing and placing all materials, including couplings and corporation stops for use on copper service; for all excavating, backfilling, compacting, and disposing of excess materials; for trench restoration, which includes seeding, sodding, or plant replacement, if necessary; for repairing leaks and defects, including defects due to settlement; and for all labor, equipment, tools, and incidentals required to complete the work.

## **MISCELLANEOUS**

### **SECTION 755 HOT-MIX, HOT-LAID BITUMINOUS CONCRETE CURB**

**755.01 Description.** This work consists of constructing a machine laid hot-mix, hot-laid bituminous concrete curb.

**755.02 Materials.** All materials including job mix formula, mixing plant, and transportation and delivery of mixture shall conform to the requirements of Section 823, Type D, except that from 0.25 to 0.50% of the total mix weight of an approved synthetic fiber shall be added. The fiber shall not ball or melt during mixing and shall provide sufficient mix cohesion to prevent slumping or breaking of the extruded curb during placement.

#### **CONSTRUCTION METHODS.**

**755.03 General.** Hot-mix, hot-laid bituminous concrete curb shall be constructed by machine methods on an approved surface as shown on the Plans, or as ordered by the Engineer.

The surface where the curb is to be placed shall be kept clean and free from dust until the curb has been placed. Unless otherwise directed, a fog coat of approved bitumen shall be sprayed prior to the placing of the curb.

**755.04 Curbing Machine.** The curbing machine shall form the curb to the dimensions shown on the Plans, or as directed by the Engineer, by a process of extrusion producing a homogeneous stable curb, free from honeycomb, and which requires no further compaction. The laying temperature and the percentage of bitumen shall be varied within the specified ranges to produce a mixture that passes through the mold without tearing and is stable enough to resist sloughing.

The curbing machine shall be operated in an uphill direction whenever practicable, as an aid to compaction.

**755.05 Curb Construction.** Curb construction shall be a continuous operation between concrete intake aprons and other concrete structures so as to eliminate curb joints at other locations.

Hand spreading will be permitted only immediately adjacent to the concrete structures and at ends of runs of curb. Hand spreading shall be performed in accordance with the pertinent provisions of Section 401. Contact surfaces of the

concrete structures shall be painted with a thin uniform coat of hot bitumen just before the mixture is placed against them.

**755.06 Inspection.** Hot-mix, hot-laid bituminous concrete curb not constructed to the required lines, grades, or cross-sections, curb placed when the mixture is too hot or too cold, and curb that is otherwise unsatisfactory shall be removed and replaced with satisfactory curbing.

**755.07 Method of Measurement.** The quantity of hot-mix, hot-laid bituminous concrete curb will be measured in linear feet (linear meters) in place and accepted, measured along the curb from end to end, with appropriate deductions for concrete intake aprons.

**755.08 Basis of Payment.** The quantity of hot-mix, hot-laid bituminous concrete curb will be paid for at the Contract unit price per linear foot (linear meter). Price and payment will constitute full compensation for furnishing all materials, for placing the curb, for removing and replacing unsatisfactory curb, and for all equipment, labor, tools, and incidentals required to complete the work.

## **SECTION 756 SAND**

**756.01 Description.** This work consists of furnishing and placing sand.

**756.02 Materials.** Sand shall conform to the requirements of Section 804.

**56.03 Sand.** After the unsuitable material has been removed and the subgrade has been approved, the sand shall be placed in accordance with the requirements of Section 202.

If sheeting is required, sand shall not be placed until the sheeting has been driven and accepted.

**756.04 Method of Measurement.** The quantity of sand will be measured as the number of tons (metric tons) of sand placed. The weight of each load will be determined according to Subsection 109.01.

**756.05 Basis of Payment.** The quantity of sand will be paid for at the Contract unit price per ton (metric ton). Price and payment will constitute full compensation for subgrade preparation; for furnishing, hauling, placing, and spreading all material; and for all labor, equipment, tools, and incidentals required to complete the work.

## **SECTION 757 RESERVED**

## **SECTION 758 REMOVAL OF EXISTING PORTLAND CEMENT CONCRETE PAVEMENT, CURB, AND SIDEWALK**

**758.01 Description.** This work consists of removing portions or all of the existing Portland cement concrete pavement, curb, and sidewalk.

**758.02 Construction Methods.** The material to be removed shall be broken by an approved power breaking machine. A ball type breaker machine shall not be permitted. Extreme care shall be exercised by the Contractor in the operation to ensure that no damage occurs to any existing buried, surface, or aerial utility. The broken concrete materials shall become the property of the Contractor and shall be removed from the Project or otherwise disposed of as specified in Subsection 106.09.

**758.03 Method of Measurement.** The quantity of removed existing Portland cement concrete pavement, curb, and sidewalk will be measured in square yards (square meters) along the top surface of the materials to be removed, as projected on the horizontal plane.

**758.04 Basis of Payment.** The quantity of removed existing Portland cement concrete pavement, curb, and sidewalk will be paid for at the Contract unit price per square yard (square meter). Price and payment will constitute full compensation for all labor, equipment, tools, and incidentals required to complete the work. All material under existing areas ordered to be removed will be paid for under Section 202

## **SECTION 759 FIELD OFFICE**

**759.01 Description.** This work consists of furnishing, erecting, equipping, maintaining, and removing a field office of Type I, II, or III for the exclusive use of Department engineers and inspectors at a location to be approved by the Engineer.

**759.02 Construction and Equipment.** The field office shall be erected by the Contractor, be fully operational when work first commences on the Project, shall be available throughout the duration of the Project, and shall be removed upon completion of the Project as defined in Subsection 101.16, or as directed by the Engineer. The field office shall be new or in a like-new condition, of weather-proof construction, tightly floored and roofed, constructed with an air space above the ceiling for ventilation, and shall be supported above the ground. The width of the field office shall be not less than 8' (2.4 m), and the floor-to-ceiling height shall be not less than 7' - 6" (2.3 m); however, in the event a trailer type field office is provided, the width shall be not less than 7' - 6" (2.3 m), and the floor-to-ceiling height shall be not less than 6' - 6" (2.0 m). The inside walls and ceiling shall be constructed of plywood, masonite, gypsum board, or other suitable materials. Exterior walls, ceiling, and floor shall be insulated. The field office structure shall be free of hazardous materials. The field office shall contain at least three windows, each having an area of not less than 540 in<sup>2</sup> (0.35 m<sup>2</sup>), and all of which shall be capable of being easily opened and secured from the inside only. All windows shall have horizontal mini-blinds covering the entire glass area. Two of the required windows must be on opposite walls. Types I and II field offices, shall have at least two exterior passage doors. Type III field offices shall have at least one exterior passage door. Door dimensions shall be not less than 30" (0.76 m) in width and 78" (2.0 m) in height. Window and door screens shall be provided. The exterior passage door(s) shall be equipped with lock(s), and at least two keys which operate the door lock(s) shall be furnished to the Engineer or inspector.

The field office shall have satisfactory lighting, electrical outlets, heating equipment, exhaust fan, and air-conditioner, all connected to an operational power source. At least one of the light fixtures shall be a fluorescent light situated over the plan and drawing table. Electrical current and any necessary fuel for heating equipment shall be furnished by the Contractor.

The Contractor shall furnish and maintain one fire extinguisher for each required exterior passage door. Fire extinguisher(s) may be chemical or dry powder and shall be UL Classification 10-B:C (minimum), suitable for Types A:B:C fires.

The Contractor shall furnish and maintain an adequate supply of cold potable water.

The Contractor shall construct and maintain a stable and unyielding all-weather parking area adjacent to the office and of sufficient size to hold four vehicles.

A suitable indoor or outdoor toilet, conforming to the requirements of the State and Local Boards of Health or of other bodies having jurisdiction in the area, shall be provided. When separate facilities for men and women are not available, a sign with the wording **REST ROOM** (letter heights of 1" (25 mm) minimum) shall be placed on the door and an adequate positive locking system shall be provided on the inside of the door to ensure privacy.

Maintenance of the field office shall be performed weekly. Maintenance shall include sweeping and mopping floors, emptying waste baskets, cleaning sanitary facilities, and replenishing supplies of paper towels, toilet paper, and drinking cups.

Except for telephone service, the Contractor shall be responsible for performing or for making necessary arrangements for all necessary utility connections, for maintenance of utilities, for payment of all utility service fees and bills, and for final disconnection of utilities. The Department will arrange for installation of direct telephone services for the official and exclusive use of the Engineer and other representatives of the Department.

Field offices will be designated in the Contract bid proposal as Type I, Type II, or Type III. In addition to the general requirements stated herein, the specified field office shall be equipped and maintained with the following:  
*Type I field office shall have a minimum floor space of 400 ft<sup>2</sup> (37 m<sup>2</sup>).*

**No. Item**

- 1 Double pedestal desk [approximately 60 by 34" (1.5 by 0.86 m)], 2000 in<sup>5</sup>(1.3 m<sup>2</sup>) minimum
- 2 Work tables [approximately 60 by 34" (1.5 by 0.86 m)], 2000 in<sup>5</sup> (1.3 m<sup>2</sup>) minimum
- 1 Plan and drawing table [approximately 30 by 96" (0.76 by 2.4 m)] with adjustable stool
- 1 Printing calculator with paper, which will add, subtract, multiply, and divide
- 1 Dry erase board with eraser and markers, 24 by 48" (600 by 1200 mm)
- 1 Bulletin board, 24 by 36" (600 by 900 mm)
- 1 Built-in plan rack with 12 holders
- 2 Metal four-drawer file cabinet [15" (380 mm) drawer width] with lock
- 1 Four-drawer fire protection file, legal size, UL rating of "Class 350" minimum, with lock
- 8 Chairs
- 4 Waste baskets
- 1 Pencil sharpener
- 1 First-aid kit, Zee Medical, Model 0155, three-shelf filled metal cabinet or equal

*Type II field office shall have a minimum floor space of 200 ft<sup>5</sup> (19 m<sup>2</sup>).*

**No. Item**

- 1 Double pedestal desk [approximately 60 by 34" (1.5 by 0.86 m)], 2000 in<sup>5</sup> (1.3 m<sup>2</sup>) minimum
- 1 Plan and drawing table [approximately 30 by 72" (0.76 by 1.8 m)] with adjustable stool
- 1 Printing calculator with paper, which will add, subtract, multiply, and divide
- 1 Dry erase board with eraser and markers, 24 by 48" (600 by 1200 mm)
- 1 Bulletin board, 24 by 36" (600 by 900 mm)
- 1 Built-in plan rack with six holders
- 1 Metal four-drawer field cabinet [15" (380 mm) drawer width] with lock
- 1 Four-Drawer fire protection file, legal size, UL rating of "Class 350" minimum, with lock
- 6 Chairs
- 2 Waste basket
- 1 Pencil sharpener
- 1 First-aid kit, same as for Type I field office

*Type III field office shall have a minimum floor space of 120 ft<sup>5</sup> (11 m<sup>2</sup>).*

**No. Item**

- 1 Double pedestal desk [approximately 42 by 30" (1.07 by 0.76 m)], 1250 in<sup>5</sup> (0.81 m<sup>2</sup>) minimum
- 1 Plan and drawing table [approximately 30 by 72" (0.76 by 1.8 m)] with adjustable stool
- 1 Printing calculator with paper, which will add, subtract, multiply, and divide
- 1 Metal four-drawer file cabinet [15" (380 mm) drawer width] with lock
- 1 Four-drawer fire protection file, legal size, UL rating of "Class 350" minimum, with lock
- 3 Chairs
- 1 Waste basket
- 1 Pencil sharpener
- 1 First-aid kit, same as for Type I field office

**759.03 Method of Measurement.** The field office will not be measured.

**759.04 Basis of Payment.** The field office will be paid for on a monthly basis for the actual number of months that the office is acceptably provided by the Contractor. Partial months will be paid for at 0.033 month per day. Price and payment will constitute full compensation for performing the work specified and for furnishing all materials, labor, tools, equipment, utilities, and incidentals required to erect, maintain, and remove the field office and restore the parking and field office area to its original condition.

The Contractor shall reimburse the Department for all telephone installation charges, but monthly charges for telephone service will be paid by the Department.

The field office and equipment shall remain the property of the Contractor.



## **SECTION 760 PAVEMENT - MILLING**

**760.01 Description.** This work consists of milling or planing existing bituminous concrete and Portland cement concrete pavement.

**760.02 Construction Methods.** The pavement milling machine shall be one which is suitable for the use in milling and planing bituminous and Portland cement concrete pavements.

Milled materials shall be reused or otherwise disposed of as specified in Subsection 106.09.

**760.03 Method of Measurement.** The quantity of pavement-milling will be measured as the number of square yards per inch of depth (square meters per 25 millimeters of depth) shown on the Plans or as the number of square yards (square meters). Any additional depth, not approved by the Engineer in writing, will not be measured.

**760.04 Basis of Payment.** The quantity of pavement-milling will be paid for at the Contract unit price per square yard per inch of depth (square meter per 25 millimeters of depth) or at the Contract unit price per square yard (square meter). Price and payment will constitute full compensation for milling or planing the existing pavement; for removing and disposing of the milled material; and for all labor, tools, equipment, and incidentals required to complete the work.

## **SECTION 761 BUTT JOINTS**

**761.01 Description.** This work consists of constructing butt joints by saw cutting and removing the existing hot-mix, hot-laid bituminous concrete or Portland cement concrete pavement to provide an area to butt the new hot-mix, hot-laid bituminous concrete pavement against the existing pavement.

**761.02 Construction Methods.** Construction methods shall conform to the requirements shown on the Plans. Saw cutting equipment shall conform to the requirements of Subsection 762.02. Any saw cut beyond the limits shown on the Plans shall be filled with approved sealant. Pavement that has been removed in order to construct the butt joint shall be disposed of as specified in Subsection 106.09.

**761.03 Method of Measurement.** The quantity of butt joints will be measured as the number of square yards (square meters) on the surface of the pavement as defined by the limits shown on the Plans.

**761.04 Basis of Payment.** The quantity of butt joints will be paid for at the Contract unit price per square yard (square meter). Price and payment will constitute full compensation for saw cutting, removing, and disposing of existing pavement; for sealing overcuts; and for all labor, materials, equipment, tools, and incidentals required to complete the work.

## **SECTION 762 SAW CUTTING PORTLAND CEMENT AND HOT-MIX, HOT -LAID BITUMINOUS CONCRETE**

**762.01 Description.** This work consists of mechanically saw cutting patch edges or tie-in joints into existing pavement.

**762.02 Construction Methods.** The equipment used shall be a saw cutting machine capable of cutting Portland cement concrete and hot-mix, hot-laid, bituminous concrete pavements. The machine shall consist of a suitable motor driven diamond blade circular cutter with control devices, mounted on a sturdy frame. The equipment shall be capable of cutting a groove in a straight line to a sufficient depth so that an even, neat joint will be cut to allow removal of material without damage to the adjacent pavement. A continuous water supply shall be supplied to the cutting element either by a water tank on the equipment or by other means. Equipment other than that specified for saw cutting may be used if the material to be cut is hot-mix, hot-laid bituminous concrete. When saw cutting Portland cement concrete for removal of pavement, the depth of saw cut shall be the full depth of the pavement.

**762.03 Method of Measurement.** The quantity of saw cutting Portland cement concrete and hot-mix, hot-laid bituminous concrete will be measured as the actual number of linear feet (linear meters) of pavement saw cut and accepted, measured along the cut, end to end.

**762.04 Basis of Payment.** The quantity of saw cutting will be paid for at the Contract unit price per linear foot (linear meter). Price and payment will constitute full compensation for saw cutting Portland cement concrete and hot-mix, hot-laid bituminous concrete and for furnishing all materials, labor, equipment, tools, and incidentals required to complete the work.

## **SECTION 763 INITIAL EXPENSE**

**763.01 Description.** This work consists of all operations necessary for the assembling and setting up of the Project, including the initial movement of personnel and equipment to the Project site, the establishment of the Contractor's offices, shops, plants, storage areas, and sanitary facilities, any other activities required by the Contract documents and by local or State law and regulation, and all other work and operations which must be performed prior to beginning work on compensable items of work at the Project site. This work also includes obtaining the required insurance and bonds, and all other items required for the start of work.

**763.02 Materials.** Such materials as are required to assemble and set up the Project that are not to be a part of the completed work required by the Contract documents shall be the responsibility of the Contractor. The determination of the adequacy of the Contractor's facilities, except as noted above, shall be made by the Contractor.

**763.03 Construction Methods.** All work done in providing the facilities and services under Section 763 shall be done in a safe and workmanlike manner.

**763.04 Method of Measurement.** Initial expense will not be measured.

**763.05 Basis of Payment.** When the amount bid for this item exceeds 5% of the total amount bid for the Contract, 2 1/2% of the total amount bid will be paid on each of the first two monthly estimates and that portion exceeding 5% will be paid on the final payment estimate. When the amount bid for this item is 5% or less of the total amount bid for the Contract, 50% of the lump sum Contract price for initial expense will be paid on each of the first two monthly estimates. Price and payment will constitute full compensation for all labor, materials, equipment, tools, and incidentals required to complete the work. Payment of the Contract lump sum price for initial expense will not be made more than once, regardless of the fact that the Contractor may have for any reason shut down work on the Project or moved equipment away from the Project and then back again. The cost of required insurance and bonds, and any other initial expense required for the start of work will be included in this Section.